The pages which are missing were removed because they were advertisements

The ARMOUR ENGINEER

VOL. XX. NOVEMBER, 1928 NO. 1

Published Quarterly by the College of Engineering
Armour Institute of Technology
Chicago, Ill.

Member of Engineering College Magazines Associated

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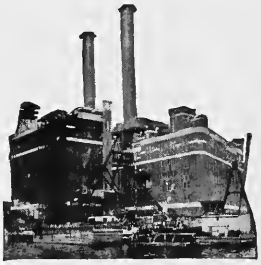

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COMBUSTION ENGINEERING

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Volume XX November, 1928 No. 1

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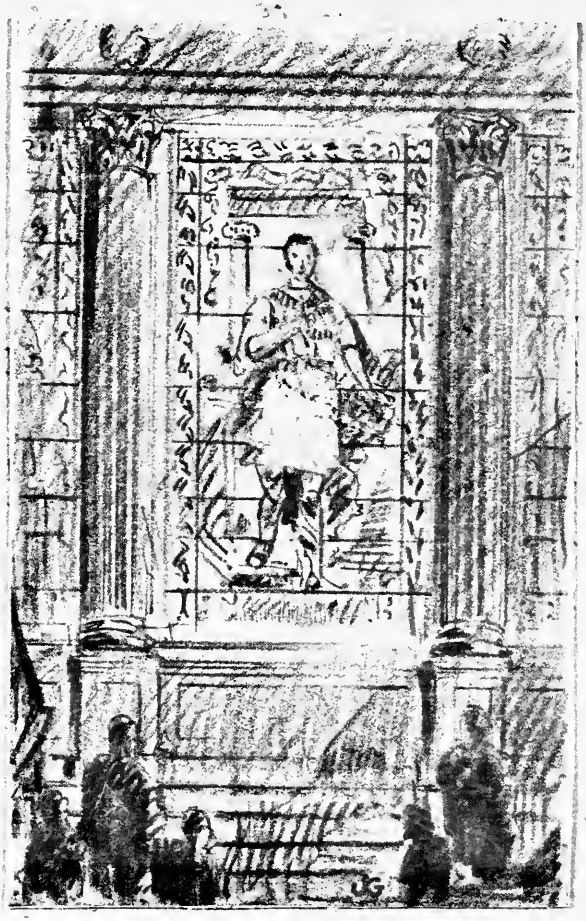
Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.



The Philip D. Armour, Jr., Memorial Window

The ARMOUR ENGINEER

VOLUME XX NOVEMBER, 1928 NUMBER 1

COMMENCEMENT ADDRESS

To the Class of 1928

By S. L. Avery

President, United States Gypsum Company

Commencement, I take it, is so named because it marks the end of a preparation and is thus the beginning — the commencement — of that for which the preparation was designed. Much is sometimes made at the formalities incident to graduation of the fact that youth is now to plunge into the stern struggles of manhood. I recall clearly being deeply impressed at the sour prospect. It cast a shadow on the glorious feeling of freedom and independence at the actual arrival of the time I could be rid of the cramping restraint of school routine and the crushing need of driving a lagging concentration to some subject which failed to arouse my enthusiasm, excite my interest, or command my respect. It suggested the fear that my preparation was inadequate.

An Englishman on a walking tour through Ireland asked his way to Dublin. The genial Irishman, who was digging peat, cheerfully led him to the top of a hill, and there, with the enthusiasm of his race and with more words than information, pointed out the bogs, the swamps and the forests he would have to avoid—and ended by saying: "As you can see for yourself, sir, 'tis the divil's own place to get through, but I'm shure that a bright man like your honor will somehow find your way." And he added: "But if 'twas meself that wuz goin' to Dublin, shure and I wouldn't start from here."

But it is from here we are to start, and there may be some virtue in the common habit of trying to guide you on the road, even if we are sure that

S. L. Avery.

bright men like your honors "will somehow find the way."

By this time you may be somewhat inured to advice, and able to endure it without serious distress. Surely you have received it in generous measure. It began in the gentle care of your loving mother; it was hidden in the lullabies that closed your eyes at bedtime. It stood upright in the rules of your childhood games. The stories you read—the songs you sing—the plays you hear — the movies you see — the radios that speak in every home—are messengers to aid or to entertain while they point the benefits of the better way and the dangers of the wrong. I grant you that it is sometimes a confusing mess. But when in bad hands these influences tend to lead us astray the common interest rises in resentment of the danger, and combats it. Broadly speaking, the very fundamentals of our civilization—education, religions, philosophies, governments—are the tested and treasured experience of the generations which have preceded us in the endless search for happiness in life. From all these sources—these substitutes for experience—you have been drawing your individual code in these preparatory years. It might seem to be enough. Unfortunately most of us take advice with a feathery lightness. If it is inconvenient we do not reject it, we conclude it is good, but decide we don't need it.

A man, meeting a friend who was holding an aching jaw, asked the cause of his pain. "An ulcerated tooth." "If I had that tooth," said the enquiring one, I'd have it pulled within an hour." "If you had this tooth," said the sufferer, "I'd have had it out two days ago."

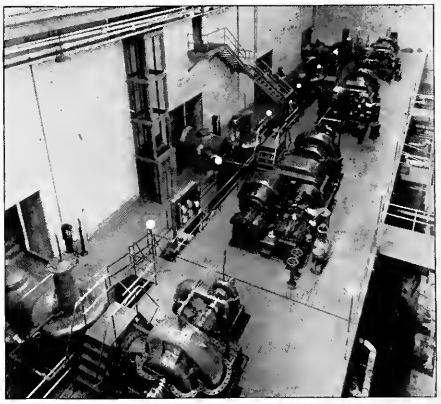
I have done myself the honor of taking this opportunity to say something in an advisory way quite seriously. It is not possible for me to offer anything original. It does not seem humane to try to sweep over you the sea of good council the waves of which have been splashing at our feet since childhood. Let us then neglect all the proved old favorites by pleasantly assuming that we have absorbed and mastered them. As this is an imaginary enterprise, let us go further. With our feet firm on the solid rock of Health, Honesty, Loyalty, Industry and Thrift, we will, with head thrown

(*Continued on page* 30)

The World's Largest Pumping Station

By M. B. Golber, '29

Student in the Department of Mechanical Engineering



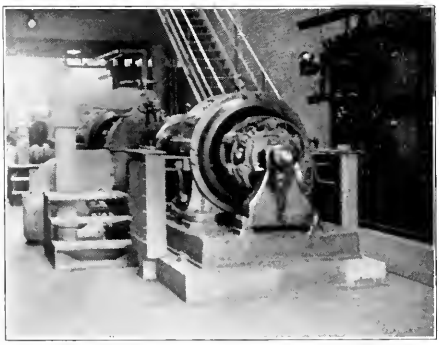
Pump Room, William Hale Thompson Pumping Station.

IN August, 1927, Chicago officially opened the William Hale Thompson Pumping Station, the latest unit in its vast waterworks system. Completed at a total cost of $9,500,000, inclusive of a six and one-third mile tunnel cut through rock for its entire distance, this station has a daily pumping capacity of 300,000,000 gallons of water to an area of thirty square miles, making it the world's largest pumping station. Exclusive of smaller piping, this station utilizes 8.6 miles of 48 inch pipe, 1.7 miles of 36 inch pipe, and 1.5 miles of 30 inch pipe, and has a daily pumping capacity that is practically one-sixth of the total Chicago pumpage.

This station is particularly noteworthy because of the turbo-pumping units employed, as it is the first to utilize the new De Laval units. Each of these consists of a high and a low pressure turbine, a large centrifugal pump which furnishes the supply to the city's mains, and a small pump for circulating cooling water through the condenser. These pumps are of standard design; the new development is in the method of coupling the turbines to the pumps.

Tandem turbines such as the Curtis, the Parsons, and the Westinghouse have been in common use for a number of years. In these types, however, the various stages all operate upon blades which are mounted upon the same shaft. With this style, in the larger sizes, it becomes necessary to connect the pump through intermediate gearing in order that large pumps may be used. This arrangement creates a very long unit, and is, therefore, in some installations an undesirable feature because of the floor space needed.

The De Laval company some years ago brought out a unit in which one turbine operated two centrifugal pumps. The turbine shaft had mounted at its end a pinion which fitted between two gears, each of which was mounted on the shaft of a centrifugal pump. These pumps could, according to the installation for which they were designed, be used either independently where large quantities of water were to be pumped at a comparatively low pressure; or they could be connected in series (staged) so as to develop higher pressures.



Two Hundred Kw. Turbo-Generator Unit.

Recently, however, this company has brought out another arrangement of turbines and pumps which it is claimed is more efficient, and it is with four of these new units that the William Hale Thompson station is equipped. In these new units there is a high and a low pressure turbine, each of which has its own shaft. Each shaft carries upon it a pinion gear which meshes with a large gear mounted upon the shaft of the pump. By this means, the two rotors of the turbines although operating upon separate shafts, unite their efforts upon the same pump, and at the same time effect a speed reduction, thus enabling a larger pump to be used. The high pressure stage of this unit, which takes steam at 300 lb. per sq. in. pressure and 200 degrees of superheat and exhausts at a pressure slightly above atmospheric, runs at a speed of 4500 r.p.m. The low pressure stage, which takes the steam from the first machine and exhausts at an average vacuum of 28¾ inches, runs at 3200 r.p.m. Owing to the speed reduction, the pump runs at 530 r.p.m.

The vacuum in the condensers has at times reached the figure of 29.2 inches of mercury, which with the average Chicago atmospheric pressure, is an extremely low pressure. Means are provided for bleeding steam for heating from the connecting piece between the high and low pressure turbines.

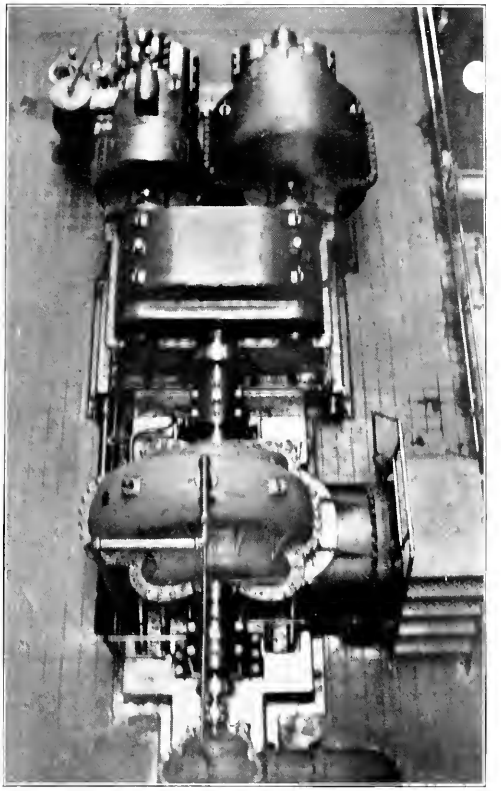
These turbines are protected by the usual oil pressure and overspeed safety devices. Two of the latter are used, one each being mounted upon the shaft of each turbine.

The pumps used on these units have been guaranteed for a lift of 20 feet, but usually operate at an average lift of 8 feet, with the maximum running in the neighborhood of 15 feet. The pumps each have a capacity of 75,000,000 gallons of water each 24 hours against a head of 150 feet. The tunnel from which the water is pumped into the city's mains, runs for a distance of six and one-third miles from the crib in Lake Michigan. It is cut through rock for its entire length, at an average depth of 140 feet below street level.

In this installation, the pumps are protected against a reversal of flow by means of a new type of valve which is coming into extensive use in the Chicago pumping stations. It is commonly known that one of the greatest dangers to be dealt with in the use of centrifugal pumps is a reversal of the pump due to a failure of the prime mover, and a resultant backing up of the water before valves can be closed to prevent this. Automatically closing valves have been installed to take care of such contingencies, but in almost all cases these valves cause water hammer, which, in the case of the large quantities of water handled by the modern pumping station, is a serious matter. The multiple port check valve, the commonest device installed to prevent a reversal of flow, has in some instances produced a water hammer so strong as to break the pipes and flood the station, which is frequently located below the level of the water supply. The use of dashpots and springs to ease the force of the blow has resulted in only partial success, and has increased the time necessary to close the valve, which is also an objectionable feature. Butterfly valves, a modification of the check, have been slightly more satisfactory, but they do not hold sufficiently tight, and still produce water hammer. The usual practice in recent pumping station construction has been the use of both a gate and a check valve on each pumping unit, but this greatly increases the initial cost of the installation, and still does not satisfactorily take care of the problem of water hammer in the event of sudden failure of the pump. In fact, such valves as the swing check and the butterfly cannot take care of water hammer, as they depend upon the reversal of flow to bring them into action.

The water department of the City of Chicago has met this problem by the installation of a new type of valve known as the automatic cone valve. These valves are in principle only hydraulically operated corporation cocks of a size sufficient to handle the flow delivered by a modern pumping unit. They are controlled by means of a small pilot valve which may be manually operated when it is desired to throttle the flow when the cone valve is being used as a gate valve; or which is automatically operated by the water flowing in order that the cone valve may function as a check valve. The partial closing of the cone valve when functioning as a gate, does not interfere with its automatic operation as a check valve, and it is always ready for rapid and complete closing in event of a failure of the pump.

The pilot valve which controls the cone valve contains a piston, one side of which is connected to a Pitot nozzle facing downstream on the downstream side of the cone valve, and the other side of which is connected to a second Pitot nozzle facing upstream on the upstream side of the cone valve. By this means there is a differential pressure created on the piston in the pilot valve which is equal to something less than twice the velocity head of the water flowing due to friction losses in the nozzles, etc. In the event that the velocity of the water were to decrease, this differential pressure upon the piston would likewise decrease, and if the pump were to stop, this pressure would fall to zero due to the absence of any velocity head. If reversal of flow were to occur, a new differential pressure would be created upon the piston in the control valve in a direction opposite to that which exists during normal flow. This change would cause a movement of the piston, which in turn would, by properly directing the operating water in the hydraulic cylinder which moves the cone valve, cause it to close. Operated as described, this valve would have the same disadvantages as the check valve, as it would not operate until reversal of flow had occurred, and thus would produce water hammer. However, by properly loading one side of the piston in the control valve by means of a spring, the piston can be caused to move before a reversal of flow takes place, and thus close the cone valve while the water is still flowing slowly in the proper direction. This absolutely prevents water hammer. When the pump is again started, the cone valve remains closed until the pump has built up the pressure to the point where the control valve piston will return to its former position. This then causes the hydraulic operating cylinder to open the cone valve.



Plan View of the New DeLaval Turbo-Pumping Unit—Capacity 75,000,000 Gallons Per Day.

In previous installations, when it was desired to shut down a pump, it was necessary to first close the valves on the discharge side of the pump, after which the pump could be shut down. With an installation such as the one in the William Hale Thompson station, it is necessary only to shut down the pump; as the flow decreases the cone valve automatically closes and does not again open until the pump has been restarted and the proper pressure built up.

After passing these valves, the water from each pumping unit passes through a Venturi tube connected to a flow meter which indicates the rate of flow and records the quantity of water discharged. These leads then join to the two 54 inch distribution mains which pass out of the station. At each end of the main header a small portion of the pumpage is diverted, and passes up into the chlorinating rooms to be treated. This treated water is returned to the system by way of the screen shafts, and the entire pumpage then passes out into the distribution system. The

(*Continued on page 26*)

UTILITIES AND EDUCATIONAL INSTITUTIONS

By George R. Jones

Vice President, Public Service Company of Northern Illinois

THE Committee on Cooperation with Educational Institutions, constituted of representatives from various utility companies, was organized in September, 1922. The activities of the Committee were defined under the major divisions of:

(1) Educational Work

(2) Executive and Personnel Work

The first of these functions was defined as *cooperation with educational institutions*. In pursuing this phase of its activity the Committee has cooperated with colleges and universities in establishing curricula of courses in public utilities, in order that a systematic and scientific approach to the problems of the industry might be realized. The contention was advanced that technical engineering courses do not, in themselves, afford a sufficient education for an understanding of the public utility industry. The engineering problems in public utilities have always loomed large, and, in the past, perhaps, have been relatively more significant than they are at present. There are, however, a great many problems involved under what may be called public utility economics which have little or nothing to do with the more purely technical engineering problems, but are, nevertheless, vital and peculiar problems of the industry. It was, therefore, a part of the original intention at the formation of the Committee that in the pursuit of this program encouragement be given to the establishment of courses in public utility economics in the various schools and colleges of business and commerce. A rigid separation of the courses in engineering and economics, however, would not serve the purpose of a broad schooling in the fundamentals of the industry. Sufficient flexibility in the curricula must be admitted in order that the students interested in public utilities may be provided with the opportunity of enrolling in both the engineering and the economics courses. The suggestion was made, therefore, that students of engineering should be permitted to take courses in public utility economics, and conversely, that students of public utility economics be allowed to take such courses in public utility engineering as would provide a well balanced knowledge of the industry.

To encourage the study of public utility problems in the institutions of higher learning was thus a vital part of the program outlined for this Committee. The point was stressed that a scientific approach to the various and peculiar problems of the industry could be made in these institutions, and that by a thorough and disinterested study of them a better understanding of the industry could be secured than by any other means.

Mr. Jones is vice-chairman of the Committee on Co-operation with Educational Institutions, a Committee functioning under the auspices of five Illinois public utility associations.

The seniors will recall with some pleasure the inspection trips made to various public utility properties one day last May, when the entire junior and senior classes were guests of the Committee. This was the first time that these companies together sponsored such trips for the students of the Institute.

The second broad function which was outlined for this particular Committee was denoted as *Executive and Personnel Work*. This function was so styled because it was proposed that the employment, assimilation and development of technically educated students should be carried on in the various utility companies by executive authority.

The growing complexities of the public utility industry have made necessary the employment of trained men and women. This, of course, is not peculiar to the public utility industry, but has been increasingly true of business and industry in general. The fact, therefore, that public utility companies became interested in acquiring an increasing number of technically trained employes was due to the attending circumstances in the development of the industry.

When this Committee was formed the thought was uppermost in the minds of the organizers that the acquisition of trained students by the various companies was only the beginning of the program. There still remained the problem of assimilating and developing them. In order that this might be carried on to a successful completion it was, therefore, recommended that the chief executive of each utility company, or an executive reporting immediately to the chief executive and thus under his direct supervision, take an interest in the progress of these students. This necessitates, of course, a personal contact with them. It was proposed, therefore, that the Committee urge the executives of the various utility companies charged with this particular responsibility to interview the students personally in order to place them in the departments for which their training and inclination seems to fit them. The executives are also urged to maintain a close contact with their progress and promotion, and to move them through the various departments of the company in order that they might obtain a more intimate knowledge of the various and diverse functions which the several departments perform.

The Committee on Cooperation with Educational Institutions thus had outlined for it the two-fold program of encouraging the study of public utility problems in the various educational institutions, and of promoting the assimilation and development of such technically trained students as the several utilities might, from time to time, find expedient to employ. Experience has shown that the policy endorsed by this Committee has materially enhanced the value of the college students to the companies as it has contributed to their advancement. As a part of their formal education, the students have had an opportunity to investigate the nature of the industry. It is thus possible for them to form a preliminary judgment as to whether or not they have a predilection for this business. They enter the utility companies with a theoretical training which should adapt them for quick assimilation and development. The companies themselves have gained by being able to concentrate on the practical training of these students which must become a part of their experience no matter how advanced their academic training may be. A certain selection has thereby been obtained. This process of selection must, of course, go on. Some of these students may find that they are not interested in the business in spite of the fact that their formal training has ac-

(*Continued on page 32*)

THE BOY TRAILBLAZERS

or Trapped in the Wilds of the North

By L. C. Kantner, '31

On a cold and drizzly morning in the early June of this year, thirty-three future civil engineers alighted from their puffing iron steed in the desolate wastes of Minocqua, Wisconsin. Ablaze with determination, they found the unknown dangers that lay before them.

After exploring the sleepy-headed town for fifteen or twenty minutes, it was unanimously voted a total loss, and the young engineers turned for consolation to the wild and woolly woods. Camp was reached via a rather precarious bus-ride through the rain and mud, the bus rather inconsiderately stopping a quarter of a mile from its proper destination. The hike to camp was made to the tune of a number of shouted pleasantries, such as "Don't get your feet wet, Willie," that undoubtedly added to the comforts and pleasures of the trip.

At first glimpse, the camp was rather depressing, what with the mud and the rain, but doughnuts and hot coffee, together with the arrival of trunks containing dry clothes and boots, soon sent spirits soaring again. Preliminary investigation soon established the fact that there were five boats, and that the woods were wet when it rained.

The first two weeks our heroes labored long and diligently, learning the intricacies and eccentricities of transits, levels, tapes, and targets. Accuracy was the constant goal of their efforts, but notwithstanding that, much work was done.

Toward the end of the season, several railroads could be found wandering about the landscape, among them being the old standbys, the L. E. and W. (Leave Early and Walk), the Armour Special, and the C. A. C. C. (Catch As Catch Can). We are sorry to report that the Trout Lake and Pacific Railroad was forced into the hands of a receiver at the close of last summer, and financial reorganization could not be effected in time for operation during the present season. Schedules will, in all probability, be resumed early in 1929.

Pleasure was not, however, allowed to interfere with business, for during the Fourth of July holidays, Meagher, Jankowski, Craig, McKana, McLaughlin, Statkus, Jacobson, and the author of this gripping epic took a canoe trip while the remainder of the camp's personnel disported itself amid the municipal benefits of Minocqua. The canoe trip was a decided success (?), the canoeists encountering in turn rapids, mill-dams, high-winds, a mislaid lake, mosquitoes, a rainstorm, feather beds, an aimlessly ambling creek, a country club where the inner man was efficiently taken care of, and a thunderstorm on Trout Lake.

The annual student-faculty horse-

shoe-pitching contest was conceded this year to the faculty by one point. In the baseball games, runs were made so fast that the games usually degenerated into track meets.

The dance hall at Trout Lake entertained a large portion of the young engineers each Saturday night. The result of a straw vote taken on the feminine contingent at these dances was "fair—but nothing to write home about." This verdict was slightly ambiguous, but no further investigation was made.

Plenty of fishing was done, but not many (real) fish were caught. General opinion had it that the fish had seen "Red" Meagher in swimming and had immediately migrated to adjoining waters.

Six young Leanders (without the usual incentive) swam across the upper end of the lake, a distance of two and a quarter miles. As though swimming was not enough, Meagher and Jankowski, with plenty of support, held several ducking parties.

On the whole, the camp this year was considered quite successful, although not as riotous as some desired.

The Philip D. Armour, Jr., Memorial Window

Last year we instituted the policy of running a series of Institute views as a frontispiece each issue. This time we are using a drawing of the Philip D. Armour, Jr., Memorial Window. This window has often been pictured in campus publications, but the majority of the student body are not familiar with its significance. We are presenting here a brief description of the window.

This window is a product of the American school of glass workers. It was designed and built by Mr. Edward P. Sperry, art director of the Church Glass and Decorating Company of New York. Mr. Sperry, an expert in the making of colored glass windows, studied both in this country and abroad. He was for some ten years associated with Mr. Louis C. Tiffany. Numbers of his windows are to be seen in churches, libraries, and institutions of learning throughout the country.

The subject given to Mr. Sperry to illustrate in the Armour memorial, *Success* was one difficult to portray, but the artist was most successful in his endeavor. In the central opening of the window is depicted the figure of a young and vigorous man. The artist has striven to express by this figure that success is something for which no one can wait, but must be grasped and conquered by brain, force, and energy. The young man has not waited until success has come to him, but has gone forth and taken from the altar of fame the crown of triumph. He has fought his way through every difficulty, has reached success and fame by his own efforts; in other words, *he crowns himself by his own deeds.*

The artist has personified in the side panels heat, light, gravity, and motion, in order to show that man, having taken these under his control, has used them for his material welfare and benefit, and also to point out to the ambitious student that in their correlation and conservation they have constantly been the instruments through which successful men have found a place in the temple of fame.

As the artist was given to understand that the memorialized was particularly interested in the study and cultivation of orchids and fleur-de-lis, he introduced into the border of the windows the conventional representation of these floral forms. Mr. Sperry's design was executed by a group of skilled artisans. It is a fitting memorial to the son of the founder of the Institute.

Modern Electric Welding

By N. S. Ewing, '29

Student in the Department of Electrical Engineering

Of the various methods used in joining metallic surfaces, electric welding is the one of most recent development. While the riveter and the blacksmith have not been crowded out, the electric welder is taking a prominent place in his field and is here to stay.

A weld is accomplished by bringing two pieces of metal to the point of fusion, allowing them to mix, and then to solidify as a homogeneous mass. Additional metal may or may not be added to the joint, depending on the method used and the condition of the materials welded. The process is a very critical one, and it is found that metals can be successfully welded only at a definite plastic heat. The range of temperatures, especially by the blacksmithy process, is surprisingly small, being only some 100 degrees fahrenheit. Fluxes enhance the flow of metal and prevent surface oxidation by the surrounding air.

It is not expected that electric welding will completely displace other methods of welding, but it is true that many jobs can be done much better and quicker with electricity. Three general methods of electric welding are recognized. There is the resistance method, the heat produced being due to the passage of electric current of high amperage through the joint between the two pieces. The electropercussive weld is also due to the heat produced in a resistance, but is completed by impact between the objects to be welded. Finally, there is the arc method of welding. The heat produced in this case is located in the arc itself, especially near the anode. Carbon or metallic electrodes may be used.

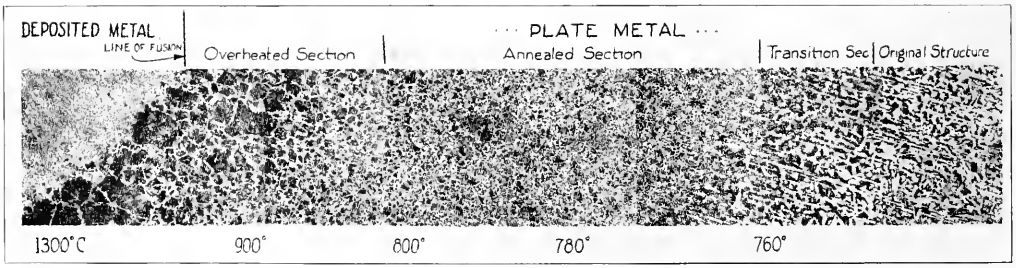
The resistance method of electric welding differs radically from all other systems in forcing through the metals to be welded a current far in excess of their normal carrying capacity. As the point of highest resistance is the joint between the parts to be welded, the maximum heat is generated in the very spot where it is required. When the proper temperature has been obtained the surfaces to be joined are pressed together to produce a perfect weld. This simple procedure is the basis of all welding of this type; differences arise in the forms of clamps to be used, and the fitting of the joint. For making seams the use of rollers for electrodes is common. Butt welds are sometimes made by the resistance process, although the clamping usually presents difficulties.

Spot welding also depends on the heat developed in a resistance by an electric current. The process is somewhat equivalent to riveting, the diameter of the spots being one-eighth to one-half inch according to the thickness of the plates. The welds do not tear loose and have greater joint efficiency than a riveted junction. The electrodes are of copper, which has a melting point below that of the iron and steel which is being welded. It is therefore necessary to cool the copper by passing a current of water through it during the process. The application of pressure to the hot electrodes at the instant of welding has a great wearing action on them and necessitates frequent replacement.

Because the heating action is dependent on the power loss in a resistance, the resistance weld can be accomplished with either direct or alternating current. The standard outfit for resistance welding consists of a step-down transformer, which is an integral part of the welding machine, apparatus for regulating the current and for automatically cutting off the current as soon as the welding heat is obtained, and clamps for holding the parts to be welded and to transmit the current to them. The temperature of the weld determines the current, which is varied by means of a multiway plug. The pressure is applied by a foot pedal connected to the clamps.

If the bluish scale left after rolling is not removed by a sand blast, it is hard to get a good weld. The resistance of the scale and rust may be overcome by increasing the voltage applied to the terminals, but after breaking the scale there is a very undesirable rush of current which often burns the plate and subjects the power equipment to an unnecessary load.

The welding machine may be operated from standard voltages or any phase of a 3-phase circuit. Regulation is now universally provided in the primary circuit of the welding transformers. The usual regulation is (1) by use of resistance in the primary, (2) by varying the number of primary turns used, or (3) by varying the field current of the generator, if the latter equipment is used. The coarse adjustment is made with the multiplug switch, which in some machines varies the primary turns by 25, 50, 60, and 75 per cent. Fine adjustment is made by means of reactances. The circuit is



Section of a Mild Steel Plate Showing Structural Changes in a One Layer Continuous Weld.

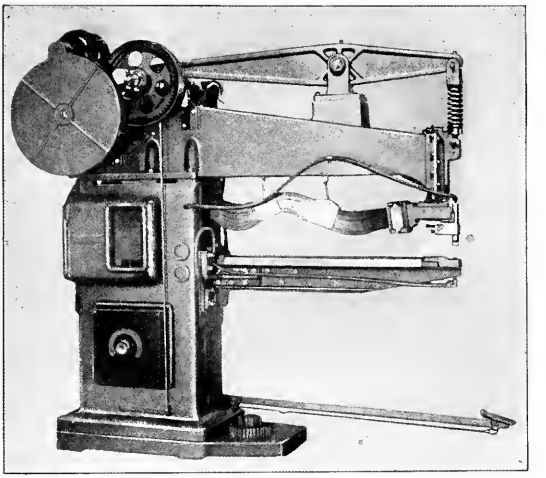
opened in the primary to avoid damage to switches, jaws, or the work caused by direct interruption of the heavy secondary current. The current in heavy welding may be reckoned in the 10,000s, but the potential difference is very small, ranging from one-half to seven volts. The energy expenditure is so small as to be almost negligible compared with the cost of labor needed to operate the machines.

Resistance welding has several advantages over other methods. In the first place, the metal is heated from the inside, or so it appears because radiation cools the outside. Hence, when the operator sees that the outer surface is ready for welding, he is certain that the core also is at the right temperature. There are no gases of combustion present, so this cause of faulty welds is eliminated. Because of uniformity of heating, the metal becomes one homogeneous mass free from porosity. The work is easy, rapid, and efficient, and the temperature is under control. The clamps used hold the work in perfect alignment and furnish the pressure to squeeze the hot metal together. All these factors combine to give economy of time, labor and material.

The fundamental characteristic of electric resistance welding is the use of very heavy currents, and its field of application is thereby limited to repetition work, where, by virtue of its simplicity, speed, reliability, and great economy, it has little competition. The application of spot welding to ship building is limited, for half of the apparatus must be on each side of the plates. Five-foot gap welders are now used, and three thicknesses of one-inch plate have been successfully joined. The application to steel construction work results in very satisfactory work, but at present the factor of portability almost eliminates it from consideration. Engineers have found rivets very reliable and are rather cautious about accepting so intangible a thing as a rivetless joint. It is true that the strength of a weld is not easily determined by inspection, as can be done with a rivet, and the effect of the welding on the metal in the vicinity is a point of argument.

The electropercussive welding process is a modification of the resistance method. It is similar in that the heating is due to the resistance to passage of current. The main difference is that the two parts are brought together at high velocity, with a condenser discharge occurring at the instant of impact. The heating, because of its suddenness of application, is extremely local, and the explosive violence of the discharge blows out any and all impurities from the joint, thus making it possible and practical to make reliable joints between almost any two dissimilar metals. The problems of unequal conductivity, unequal expansion, and differences in melting points and chemical characteristics are eliminated.

Electropercussive welding has been extensively used for joining aluminum wires, copper and aluminum wires, and thermocouple wires. This method has been used in the jewelry trade for joining platinum; putting sterling tips on table cutlery; putting pins on badges and brooches, and similar applications. It is used in joining copper and aluminum in field coil leads, and for the attachment of small platinum, silver and tungsten contact points.



Example of a Modern Power Driven Deep Throat Spot Welder.

When a high potential gradient is applied to air at atmospheric pressure the air may be ionized and an arc formed. Enough heat may be developed to melt and vaporize the electrodes and cause the material of one to be deposited on the other electrode. The direction of the flow of metal is from the cathode to the anode. A Russian engineer, Benardos, was the first to apply the carbon arc to welding. The carbon pencil was one electrode, the object to be welded the other. If cracks were to be filled metal had to be added. Slavianoff substituted a steel or iron rod for the carbon and fused the electrode at the same time the object was being welded. Details of each operation were for a long time guarded as trade secrets, so development was slow. Both carbon and metallic arcs are alike in that the greatest voltage drop is near the anode and hence the greater part of the heat is developed here. For this reason the object to be welded is made the anode. If alternating current were used, as is sometimes done, the hot spot is first at the object and then at the rod and any advantage of concentration of heat is lost.

Arcs are peculiar in having a negative characteristic. That is, the greater the current the less the voltage required to maintain the current. Instable operation occurs if the arc is connected to a constant potential or overcompounded source, for upon a slight decrease in length of arc a short circuited condition is approached. Similarly, the arc is prone to go out suddenly. On direct current, the presence of an inductance in circuit has a stabilizing tendency.

The graphite electrodes used vary from one-quarter to an inch and a half in diameter, depending on the current requirements for the work in hand. This is held in an insulated holder and the arc struck by bringing the carbon in contact with the work and quickly drawing it away a few inches from the metal. Best results are obtained with arc voltages of from 75 to 80 volts, and as the current ranges from 200 to 500 amperes, the generated voltage should not be too high or large losses in regulating resistances will result. The carbon arc is never used on alternating current because the electrode must always be negative. Otherwise, carbon would be deposited and contaminate the weld. For heavy cutting, repair of defective castings, and for general work, the carbon arc is very useful, as it is very adaptable and economical.

For general repair work and light, delicate work the metallic arc is the one to use, but as yet it is not suitable for welding copper or its alloys. While the length of the carbon arc as used in welding is from one and a half to six inches, the metallic arc rarely exceeds three-sixteenths inch. The current range is usually from 50 to 175 amperes and the voltage 18 to 30. This system of welding has an advantage over all other systems in that the metal from the electrode is carried

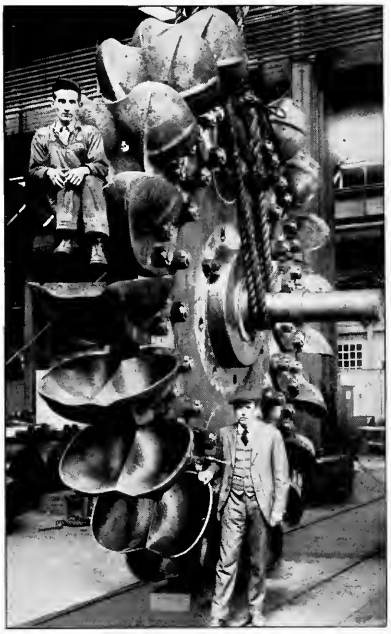
(*Continued on page 32*)

Developments in Hydraulic Turbines

By R. H. Earle, '17

Assistant Engineer,
Hydraulic Turbine Department,
Allis-Chalmers Manufacturing Company

Part I



Disk and Buckets for a Large Impulse Wheel. The Wheel Shown Weighs 25 Tons. These Large Wheels Are Generally Used in Pairs.

DEVELOPMENTS in hydro-electric machinery are holding a leading place even among the newer mechanical arts of our time and the designing of large water-power projects is one of the most fascinating lines of engineering today. In a water-power installation of large size each major element from the dam to the transformers has been especially designed and built for that installation so that a great amount of engineering is necessary in all sections of the work. The water turbines particularly require special design as they must be proportioned to suit the flow conditions of the river. The electrical equipment is somewhat less special except on the very largest installations. The companies manufacturing hydro-electric machinery are not manufacturers in the usual sense of the term but are rather machinery engineers and contractors who not only design the machinery but must frequently devise special manufacturing methods for each individual job.

Large water-power developments in this country nearly always form a part of a large power system. Usually such stations work in conjunction with the steam stations. A water-power plant is a very reliable source of power and near full load is very efficient. This efficiency drops off at part loads. Steam turbines on the other hand can operate efficiently at part loads and when so operating the automatic stokers adjust the rate of coal burned to suit the load. The usual scheme of operation is accordingly to run the water turbines at their most efficient load so as to get the most power possible out of the water and absorb the fluctuations in load with the steam turbines.

This co-operative spirit between steam and water turbines appears only after the plants are built. The proposed water-power plant usually has a long fight against its steam competitor. A hydro-electric development can be made at a very limited choice of sites all likely to be inconveniently located, whereas a steam plant can to a much larger degree, be located near the load center. Furthermore, a steam plant can be built a portion at a time, the size of the plant and the amount of money invested in it increasing as the market for power grows. In the case of a hydro plant, however, the big expense is nearly always the acquiring of lands to be flooded and the building of the dam and power house. The cost of the machinery is a comparatively small item. Hence the initial cost of a hydro plant is large, whereas additional generating capacity can be installed at a moderate cost. As a result a hydro plant is sometimes a losing investment for the first few years of its life. The cost of a steam plant can be estimated very accurately whereas unlooked for difficulties frequently develop in the building of dams and other large structures connected with the water-power plant and in addition there is often the added hazard of floods while construction work is going on. The output and revenue of a steam plant can be predicted very accurately whereas incomplete stream-flow data makes the maximum power available in a river difficult to determine in advance and finally, the steam-power plant designers are making tremendous economies in the use of coal. We see, therefore, that there are inherent advantages in favor of steam and definite financial risks in most water-power developments; unless the hydro-electric plant promises a substantial profit over the steam plant, it is not undertaken.

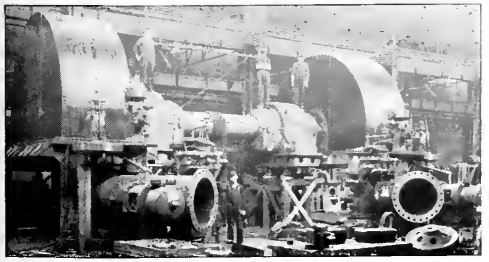
This long and discouraging list of handicaps would seem to leave little excuse for the existence of water-power plants, yet they have advantages to their credit and water power, wherever available in quantities, forms an important part of the power supply. A water-power plant is inexpensive to operate and very little skill is required on the part of the attendants. The moving parts are few in number and are all very substantial and reliable. Hydro-electric units often run for months at a time without a shutdown and operate for years without major repairs. Compared with an automobile, for instance, a turbine is hardly well broken in after having run the usual life period of a car.

In comparing our coal and water power it appears at first sight that water power occupies an insignificant position, but this is because so much of our coal is used for purposes other

than generating power. If we compare our water power and the power portion of our coal it is seen to be of considerable importance. Our water power now supplies about one-third of the power load of the country. If all the water power in the United States were developed it would just about carry the present power load. The further deduction can be made that so much coal is used for other than power purposes that the amount left underground by reason of water power constitutes a comparatively small saving.

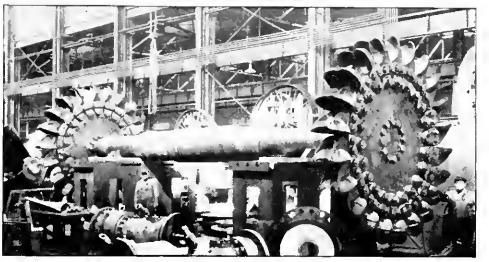
One other element in the importance of water power is its distribution. The western states have an abundance of water power which compensates in some measure for their general lack of good coal and the expense of transporting it. In our western states water power is the main stand-by, and in Canada, as another example, there exists the extreme case of 97 per cent of the central-station power coming from water.

Let us consider now some features of modern hydraulic turbines. A water turbine is required to meet two main conditions: Its design must be suitable to utilize the water in whatever amounts and heads that nature happens to provide and the turbine shaft must turn at some reasonable speed. At the very highest heads thousands of horsepower are obtained from a stream of water a few inches in diameter and one problem is to design the turbine to run at sufficiently slow speed. At the other extreme are the low-head developments where whole rivers may be run through the turbines and the problem is to obtain the power from these large sluggish streams at a reasonably high speed of the turbine shaft. Reasonable speeds for large turbines range from 90 to 450 r.p.m. Large water-power developments in the United States now cover heads ranging from 7 to 2300 feet corresponding to pressures of about 3 to 1100 pounds per square inch. The turbines required for the various heads would hardly be recognized by the uninitiated as belonging to the same class of machinery.

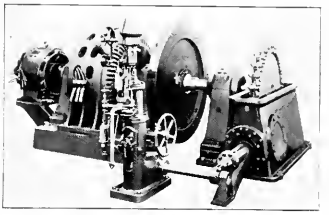


Shop View of a Large Impulse Wheel Unit Without Generator. The Nozzle Pipes with Oil Pressure Cylinders for Controlling the Needle Are Shown Below the Housing.

For heads over 1000 feet the impulse wheel is used almost exclusively. The impulse wheel is essentially a paddle wheel turned by a jet of water squirting into the paddles or buckets. These buckets are carefully shaped to extract the greatest amount of power from the water. The buckets each consist of two bowls meeting in a sharp edge. The jet strikes this edge, is split and flows into the two bowls of the bucket; it is finally thrown off on either side clear of the wheel. The diameter of the wheel is made large so that its speed may be moderate even though its peripheral velocity is high.



Disks and Shaft for Large Impulse Wheel. These Are Always Built With Horizontal Shafts. The Generator Rotor Is in the Middle, with an Impulse Wheel on Each End.



A Typical Small Impulse Wheel and Generator. A Flywheel Assists in Speed Regulation.

A small impulse wheel and generator are shown in one of the illustrations. This picture shows the nozzle pipe, governor, impulse wheel, flywheel, generator and exciter.

Large impulse wheel units nearly always consist of a horizontal generator with the shaft extended on both sides, an impulse wheel being mounted on each end of the shaft.

All the large impulse wheels in this country are used in California and for many years the world's records for size have been held by California machines. Among the latest installations occur the following:

San Joaquin Lt. & Power, 2243 ft., 40,000 hp.

Southern Calif. Edison, 2300 ft., 60,000 hp.

City of Los Angeles, 870 ft., 32,200 hp.

Some conception of the magnitude of the forces involved can be gained from the following characteristic data on the Southern California Edison machine just mentioned.

The output of 60,000 hp. is enough to supply a city of about 60,000 inhabitants.

The total weight to be carried in the two 30-inch ring-oiling bearings is about 238 tons. This includes the generator rotor weighing about 295,000 lbs. and two steel wheel discs with 23 buckets, each bolted to the overhung end of the shaft. Each disc and runner weighs about 55,000 lbs. and each bucket is a steel casing of about 900 lbs. weight.

The unit will develop about 30,000 hp. at each overhung wheel under 2,300 ft. net head at 250 r.p.m. Later on the diameter of the wheel runner may be reduced so as to operate with high efficiency at 300 r.p.m. when a change of the power-system frequency is made from 50 cycles to 60 cycles.

The water developing the 30,000 hp. on each wheel side is discharging from a needle-controlled orifice, which produces a jet of about 8½ inches diameter flowing at a speed of about 250 miles per hour and producing upon the bucket an impact force of about 45 tons. The buckets, traveling at a peripheral speed of 120 miles per hour are held to the disc by three steel bolts which must withstand a large and quickly pulsating force.

The centrifugal force at the normal speed of 250 r.p.m. is about 68 tons per bucket and will be 80 tons when operating at 300 r.p.m. later. In case of the runaway of the unit these forces will increase to about 300 tons per bucket.

Outside of this centrifugal force the bucket is subjected to the impact force from the jet which increases from zero pounds at the moment the bucket enters the jet to 90,000 lbs. when the full jet plays upon the bucket and decreases to zero when the next bucket has entered the jet completely. A maximum resultant force of about 82 tons at 250 r.p.m. must thus be taken up in three bolts holding the bucket to the disc.

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ENGINEERING NEWS

North Side Sewage Treatment Plant

Chicago's position as the most healthful city in the world was fortified with the addition of a new sewage treatment plant on the far north side. This plant, erected at a cost of $32,000,000 takes care of a district inhabited by a population of 1,000,000. The formal opening and dedication took place on October 3, before a large gathering of officials and visitors. Use was made of "Televox," the mechanical man, in placing the plant in operation through the spoken command of Mr. T. J. Crowe, President of the Chicago Sanitary District Board of Commissioners.

The new plant makes use of the activated sludge method of sewage treatment which was described in detail in the January, 1928, issue of the ARMOUR ENGINEER in an article written by H. E. Larson '28. Three batteries, each containing twelve sludge tanks, take care of the daily capacity of 400,000,000 gallons of sewage.

This project, which was five years in the making, was undertaken by the Sanitary District upon demand of the Secretary of War, in return for the diversion by this district of 8500 cubic feet of lake water per second. This new plant will assure the inhabitants of Chicago that their water supply will not be changed or diminished by order of the Federal courts. The highest praise is expressed by all noted engineers for the work of the Sanitary Board in this new installation.

The New Chicago Daily News Building

More and more cities are utilizing valuable space to relieve congestion and to hide unsightly railway terminals by covering their railroad tracks with buildings. The first notable development of "air rights" in the greatest railroad center of the world is now under way with the construction of a twenty-five-story skyscraper, the new home of the Chicago Daily News.

Although the building itself stands almost entirely on actual land purchased outright, the greater part of the plaza is over the tracks of the Chicago, Milwaukee, St. Paul & Pacific Railroad. Despite the fact that the work is progressing above and around ten tracks, the regular train service is being carried on without interruption. In this network of tracks 100 caissons have been sunk more than 100 feet to bedrock under the main structure and 59 caissons under the plaza 60 feet to hardpan. This has required more than two and one-half

Chicago Daily News Building.

miles of boring and was done by erecting scaffolds and platforms for the dirt bucket elevators in order that trains could run underneath. Under the main building each caisson will bear a load of 3,000,000 pounds, and under the plaza each caisson will have a load of 1,000,000 pounds.

One of the unusual features of the building is its vast chamber and exhaust to lead off smoke from the trains. A ceiling covering the entire track area contains specially designed slots over the center lines of the tracks, with openings greater than the width of the locomotive stacks. These lead into the smoke chamber, varying in height from two to ten feet, from which the fumes are led up through the stacks to the top of the building. The main stack contains 220 square feet of area and extends 335 feet above the tracks. In case the gravity exhaust for the stacks is not sufficient, motor-driven fans are to be installed on the roof. When the railroad is electrified as it is hoped at a later date, the space devoted to the smoke stack will be converted into office room.

The structure is being built of steel and Indiana limestone and has the stepped-back design. At the ground floor it is 212 feet wide and nearly 400 feet long, leaving a space of approximately 150 by 250 feet for the plaza.

The Daily News building is expected to be the center of a new Chicago skyscraper section. West of the main business district, also north, south, northeast and southeast, are acres and acres of track space suitable for "vertical subdividing." Real estate experts have estimated the value of this close-in property to be in excess of $400,000,000. Such an "air-rights" development will bring innumerable engineering problems similar to those now being met in this initial project.

Radiation From the Aurora Borealis

Dr. Elmer A. Smith, of Secaucus, N. J., has just completed a series of interesting experiments conducted during recent manifestations of the aurora borealis, more commonly known as the "northern lights." The data obtained from these researches suggest that the high-frequency rays and electromagnetic waves discharged from the aurora borealis are the direct cause of disturbances in high power transmission systems. The rays have an exceedingly high penetrating power and cover a wide range of frequencies.

These experiments were conducted by the aid of a concrete pipe shaft with a lead lining, installed in the channel of the Hackensack River, the electroscopes and other sensitive instruments used in the experiments being mounted at the base of the shaft. The atmosphere exercises a marked absorption effect, being equivalent to 28 feet of water. Since the high-frequency rays were found to be capable of penetrating 103 feet of water in addition to the atmosphere, the

(*Continued on page* 34)

CHROMIUM AND CHROMIUM PLATING

By I. G. Klein, '29

Student in the Department of Chemical Engineering

IT is almost 75 years since Bunsen first obtained metallic chromium by electrolysis of chromic acid, but it is only very recently that the plating of chromium on iron and steel and other metals has been realized. This successful plating of chromium has long been sought by the plating industry because of the properties of chromium.

Metallic chromium is the hardest of the elements, and is ranked in hardness next to the diamond. It has also the very desirable property of being a bluish-white in color, which makes it usable in place of silver, giving us our stainless steel cutlery. It possesses high resistance to corrosion and tarnishing influences, such as all alkalies, oxygen, chlorine up to 300 deg. cent., sulphur, superheated steam, and concentrated nitric and sulphuric acids. Chromium, however, as a metal is too brittle to be used alone, but readily lends itself to alloying and plating now that the proper conditions are understood and obtainable.

The above properties immediately bring to mind a number of varied uses to which chromium plated metals can be adapted. Some of these are in the manufacture of plumbing fixtures, watch cases, automobile trimmings, machine parts, cutlery, surgical instruments, and in the plating of surfaces subject to considerable wear.

The printing industry has found that by chromium plating their type and the intaglio plates to be used in engraving, they can make these plates last practically indefinitely. Formerly these plates had to be case hardened or nickel plated, but the cloth used in wiping them quickly wore away the surface, and they had to be replaced. With a coating of chromium only two ten-thousandths of an inch in thickness, the plates give a better impression and last longer than the nickel plated or case-hardened plates. When the chromium does wear, the plates can be stripped and replated.

A resumé of the history of chromium plating would read somewhat as follows: Bunsen, inventor of the Bunsen burner, produced metallic chromium electrolytically in 1854, by using a two compartment cell and $CrCl_3$ (chromium chloride) as the electrolyte. Placet and Bonnet in September, 1894, found that the most common compound from which chromium can be obtained commercially is chromic acid. In 1898, two Englishmen, Moller and Street, patented a process, in England, using as their cathode solution chrome alum, sodium sulphate and water in equal parts by weight. Their current density was 40 amperes per sq. dm. at a temperature of 90 deg. cent. Their yield of chromium indicated an efficiency of 30 per cent. Cowper-Coles in 1900 found that a chromic chloride solution of 250 gm. per liter at a temperature of 88 deg. cent. and a current density of five amperes per sq. dm. gave good deposits of chromium. Corveth and Mott in 1903 investigated the deposition of chromium from chloride and sulphate solutions using a double cell with lead anodes and copper cathodes. They found that it was possible to deposit chromium from these solutions if the solutions were not disturbed and a chromous salt was kept in the presence of the solution. In 1905 Corveth and Curry investigated and substantiated the previous work. LeBlanc in 1906 by using lead anodes and copper cathodes, and a catholytic solution having a concentration of 89 gm. per liter of chromium, the anolyte being sulphuric acid, obtained thin deposits of chromium successfully; thicker deposits tended to crack. Salzer in 1908 took out a German patent claiming a flexible deposit of any thickness.

In 1920, G. J. Sargent obtained good, thick deposits of chromium on copper using a platinum anode and a single cell arrangement. E. Lubreich obtained adherent deposits on iron, copper, nickel, and brass. His anodes were of platinum and also of iron. His solution contained chromic acid partially reduced to chromous acid. Since this time the work has come along so swiftly that it is almost impossible to give credit to any one man. It is a known fact, however, that chromium has been successfully plated on most of the common metals with the exception of aluminum. In the case of iron and steel, however, the danger of cracking of the plated surface makes desirable a coating of copper or nickel before the chromium is applied.

In commercial plating of chromium, the article to be plated is the cathode and is connected to the positive side of the source of current, while the anodes are of a type which are insoluble, lead being generally used. Metallic chromium has not been used for anodes probably because pure chromium in the form of chromic acid is less expensive and more readily obtainable. The tanks which contain the plating solution are either steel, lead, or crockery lined. It can easily be seen that in the process of plating the chromium in the bath will be used up and must be replaced. This is accomplished by periodic additions of chromic acid.

One of the drawbacks to the success of chromium plating, and one which can be said to be the Waterloo of the plating industry, is the health hazard. At the cathode of the plating bath we have a great amount of hydrogen liberated, and at the anode we have oxygen liberated. These two cause a fine acid spray which destroys the tissues of the respiratory tract. Several days usually pass before the effects of the fumes are felt by which time the damage is done, and the worker incapacitated for several weeks. Symptoms are painful internal sores. To prevent this as much as possible, ventilating hoods are sometimes used, but these are dangerous if they form too close contact between the explosive mixture of hydrogen and oxygen. Another device used in safeguarding the health of the workers is to use a sheet metal duct, having a slot on the side facing the liquid, surrounding the top of the tanks. Air is drawn through this duct at a great velocity causing a draft carrying away the fumes from the bath. Another means of removing these fumes, and one which is typical in the plating industry, is to pour kerosene on to the plating solution after the current is turned on, and the "plates" immersed.

Another precaution necessary is known in the plating industry as the degasification treatment. The process consists of the removal from the surface of the metal to be plated of all the absorbed and occluded gas which, if allowed to remain, would cause scaling and cracking of the metal surface plated on. The method of degasification invented by Charles Mad-

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THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering
ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XX **November, 1928** **No. 1**

Make The Armour Engineer the best technical college publication in the country.

Be noble! and the nobleness that lies
In other men, sleeping, but never dead,
Will rise in majesty to meet thine own.

—Lowell.

ON BECOMING A MONTHLY. With the beginning of the twentieth year of publication of the ARMOUR ENGINEER, the staff is looking forward to a banner year. During our twenty years of existence we have evolved slowly and surely into a magazine worthy, we believe, of our slogan. We have no thoughth of dropping our slogan, however, for even if we were to become satisfied in ourselves, then comparison with other similar publications would show us new angles in which to excel, new projects to attempt, new effects to create. Indeed, the harder the staff works, the more fascinating becomes the work, and efforts are redoubled. It is an excellent state to be in, that in which the efforts of the meanest staff member are inspired not by thought of material reward, but by the thrill of participation in a creative undertaking.

The staff this year is considerably enlarged. Some dignity, perhaps, has been added among other things, by the addition of a managing board and an alumni advisory board. The time has passed when the ENGINEER could be supervised, compiled, and edited by one or two men—hence the managing board and the enlarged staff. The staff believes that the weighty matters we are about to consider demand that we secure the counsel of our predecessors more fully than has been done before—hence the alumni advisory board.

With this very excellent staff organization we are about to turn our attention to bigger and better things. Chief among these is a proposed change in the scheme of publication. We have for twenty years been a quarterly. In this time the great majority of our contemporaries (many of them much younger than ourselves) have become monthlies. We of the present staff believe that the monthly plan is far superior to ours, and that we are now ready to consider the adoption of the former.

The monthly plan offers many advantages. In the first place it will keep the student in closer touch with the contemporary engineering world. It will give him a greater opportunity to write for publication, as well as making available a wider variety of subjects to be treated by the graduate engineer. It will give more students an opportunity to do staff work, and will develop the executive ability of the holders of major staff positions to a greater extent. The routine of staff work would be carried out more smoothly. Are these arguments not weighty enough?

Add then that the ENGINEER would be on an equal basis with the other contenders for national honors in the Engineering College Magazines Associated. At present we must in our four issues surpass the efforts of those having twice the opportunity to rectify mistakes and better their all-round appearance. Add also an increased prestige among engineering colleges and national advertisers.

We do not propose a change to eight issues at once, but suggest a change to five this year, if details can be worked out in time; then a change to six next year; then eight issues the following year. Were we sure of sanction we would advocate eight issues next year, for we feel capable of it. By the extended period of change we ultimately reach our end, and at the same time do not displease the more conservatively minded.

As far as we can see there remains only the financial side to be settled before we may ask consent to the change. We do not

believe that the change would increase the cost to the student any great amount. A drive for greater revenue might make possible the retention of the old subscription price.

This matter is now being investigated. We hope to be able to present a detailed plan to the student body in the very near future.

PRESIDENT-ELECT HOOVER. The national election this month was epoch-making in many respects, the most interesting to engineers and engineering students being the election, for the first time in the history of the country, of a trained and experienced engineer to its presidency. Many of the voters who cast their ballots for Mr. Hoover may not have taken his profession into account before making their choice. But his exceptional administrative skill in carrying out great undertakings of humanitarian, governmental, and economic character, which doubtless had decided weight with the voters, was gained as the result of his professional training and widespread practice.

Engineering training taught him to analyze all problems and seek the facts bearing on them before reaching a solution. Engineering practice in many parts of the world brought him into contact with men of different races and nationalities and, still being an observant student, he increased his knowledge of human nature from which he developed his proficiency in selection of personnel to help carry out important projects. In designing and constructing mining and metallurgical works in remote regions he acquired a mastery of economics and skill in handling and scrupulous accounting of large sums of money.

Thus splendidly equipped, Mr. Hoover was ready for the greater opportunities presented at the opening of the World War. For over four years he undertook the feeding of children and other non-combatants in Belgium. After the armistice this relief work was extended to other famished parts of Europe. During our participation in the war Mr. Hoover was also food administrator here. Then as secretary of commerce under two administrations he set new records for effectual cooperation between the governmental and business interests. All these vast undertakings were carried through unostentatiously, but so effectively as to bring world-wide admiration.

Mr. Hoover's remarkable career is a splendid one for young engineers to study and emulate. Other men have risen from the farm to the presidency, but not heretofore through engineering. The importance of engineering problems in local, state and national governments has steadily increased. Mr. Hoover's election is a fitting recognition of the engineer in the most influential of these governments. It should serve to broaden the engineer's horizon, but he in turn must rise to see his opportunities in this broadened field.

CIVIC DUTY. It is only a few weeks since the engulfing wave of political hokum has receded from our immediate attention. This year the engineer was interested in the progress of the campaign more than usually because one of the presidential candidates was an engineer.

The usual noise was made over the qualities of the two leading candidates. One incident, however, was especially displeasing to us. True, it was a minor incident, and the specific charge was not common. But the impression it presented should be investigated.

A woman, speaking in a debate on the relative merits of the two candidates, charged that Hoover was inferior to Smith because he was an "engineer," and had worked only with "blueprints," whereas Smith was a statesman and was used to working with men. The statement in itself is not worth discussing, but there is a lesson for the young engineer behind it.

The speaker was not at all familiar with the work of the engineer. Why? After all, is it the duty of the public to investigate such matters or is it the duty of the engineer to acquaint the public with his qualifications? We will agree that the latter procedure should predominate.

And how, if not by a more active participation in civic affairs? For some reason the engineer has seemed always willing to take a back seat and leave the management of public affairs to the incompetent. Surely the engineer has ample opportunity to develop his administrative ability. Why should not this talent be used for civic betterment?

There is no reason why such technical questions as flood control, waterways, and water-power resources should be left for decision to the politician who knows nothing about them. What a saving of time and energy, speech-making, and irrelevant discussion would be made if only engineers were called on to settle them.

The signs are encouraging, however. The placing of a prominent engineer in the White House is a great step forward in the bringing before the public of the engineer. We expect a great increase in the civic activity of the engineer.

Two Seas

There are two seas in Palestine.

One is fresh and fish are in it. Splashes of green adorn its banks. Trees spread their branches over it, and stretch out their thirsty roots to sip of its healing waters.

Along its shores the children play, as children played when the Master was there. He loved it. He could look across its silver surface when He spoke His parables. And on a rolling plain not far away He fed five thousand people.

The river Jordan makes this sea with sparkling water from the hills. So it laughs in the sunshine. And men build their houses near to it, and birds their nests; and every kind of life is happier because it is there.

The river Jordan flows on south into another sea.

Here is no splash of fish, no fluttering leaf, no song of birds, no children's laughter. Travelers choose another route, unless on urgent business. The air hangs heavy above its waters and neither man nor beast nor fowl will drink.

What makes this mighty difference in these neighbor seas?

Not the river Jordan. It empties the same good water into both.

Not the soil in which they lie; not the country round about.

This is the difference—the Sea of Galilee receives but does not keep the Jordan. For every drop that flows into it another drop flows out. The giving and receiving go on in equal measure.

The other sea is shrewder, hoarding its income jealously. It will not be tempted into any generous impulse. Every drop it gets, it keeps.

The Sea of Galilee gives and lives. This other sea gives nothing. It is named *The Dead*.

There are two kinds of people in the world.

There are two seas in Palestine.

—Bruce Barton.

John W. Urban

John W. Urban, honor graduate in the chemical engineering department in 1927, winner of the first prize in the 1926 Essay Contest of the American Chemical Society, and president of his senior class, died August 2 in Charleston, West Virginia, as a result of burns received a week before in an explosion of the Carbide & Carbon Chemical Corporation's unit at which he was employed. He would have been twenty-three years old in September.

John Urban was born in Chicago, September 18, 1905. Later he removed to La Grange, Ill., where he lived with his parents at 321 South Brainard Avenue. After graduating from the Lyons Township High School, he entered Armour Institute in the fall of 1923.

His record of student activities was exceptionally brilliant. Besides graduating with highest honors in his department, he was president of the graduating class, president of the Armour Branch of the A. I. Ch. E., and captain of the golf team which won the Western Intercollegiate Championship in 1927.

He was also a member of the staff of the Armour Engineer. The four cover designs of the year 1926-1927, which won first prize in the competition of the Engineering College Magazines Associated that year, were drawn by Mr. Urban.

After graduation he worked in the laboratories of the Linde Air Products Company. A little later he was transferred to Charleston, West Virginia, where he was operating for the Carbide & Carbon Corporation as assistant foreman at that plant.

John W. Urban was a member of Tau Beta Pi, honorary engineering fraternity; Phi Lambda Upsilon, honorary chemical fraternity; Sphinx, honorary literary fraternity; and the Honor A Society. His many friends in these groups, with a host of others, will miss him.

Clarence E. Freeman

With sincere regret we record the passing of C. E. Freeman, '97, on October 27, 1928. As a student, a professor, and later as head of the department of electrical engineering, he endeared himself to his many friends. Many about the Institute still remember him with deep affection.

In 1906 he left the Institute to engage in work more favorable to his health. He was for a long time in the employ of the Arnold Company, consulting engineers. His later work was as an oil geologist. For the last three years he had retired from active work because of failing health. He was 61 years old at the time of his death.

We extend our sympathy to his brother, Prof. E. H. Freeman, of the electrical engineering department.

College Notes

NEW BOOKS IN THE LIBRARY

The following titles are among the books received in the Library, September, 1928:

Bone, W. A., and D. T. A. Townsend. *Flame and combustion in gases.* A comprehensive review of the results of modern research (since 1880) regarding gaseous combustion and explosions.

Cressey, G. B. *Indiana Sand Dunes and Shore Line of the Lake Michigan Basin.* Relatively little has been done in the study of this area. Mr. Cressey describes the origin of the dunes and deals primarily with the geographical and geological items of the subject.

Fraser, H. F. *Foreign Trade and World Politics;* a study of the international foundations of prosperity with particular reference to American conditions. Interesting now in a time of national political campaigns. Tariff policies of the U. S. and foreign debts are well treated for those who have an interest in, but small knowledge of them.

Goddard, Fred. *Thermionic Valve;* its construction, action and control. A useful book for all who take more than a superficial interest in wireless. A fund of information formerly available only to advanced wireless experimenters is given, which will explain many problems and difficulties to the average constructor.

Jusserand, J. J. *English Wayfaring Life in the Middle Ages (XIVth century).* This book is based on the records of old England and is a very fine presentation of certain phases of the life of our English speaking ancestors. It is a new edition, the original being published in 1884. For the engineers the chapter on "Roads and Bridges" should have a special interest.

Ludwig, Emil., *Napoleon.* Ludwig has become world known for his way of presenting biography. This volume is a brilliant and dramatic picture of his hero, with less attention than is usually paid to the military genius and more to character analysis of Napoleon and the traditions of his time.

Martin, A. J. *Activated Sludge Process.* The development of the process is treated through its various stages and the working methods compared. Descriptions of a number of installations are given.

Russell, Bertrand A. W. *Analysis of Matter.* A discussion as to whether the world as shown by modern physics can be reconciled with that revealed by common sense. It is written for the layman, interpreting his discoveries of a difficult subject in every day terms.

These titles are from the list of new novels and general subjects: Cannon, C. J.—Red Rust; Galsworthy, John—White Monkey; Kaye-Smith, S.—Iron and Smoke; Macaulay, Rose—Daisy and Daphne; McFee, William—Ocean Tramp; Stephens, James—Etched in Moonlight; Akeley, C. E.—In Brightest Africa; Andrews, R. C.—On the Trail of Ancient Man; Arliss, George—Up the Years from Bloomsbury.

CHANGES IN CURRICULUM

At the beginning of each year, the Dean's Office is confronted with the problem of arranging the programs of the various departments and classes in such a manner that every classroom will be utilized, and that there will be no confusion resulting from conflicting programs.

This year, however, because of the size of the freshman class, all the first-year classes are being held in the afternoon, and the shops in the morning. In this way, classrooms that would otherwise be vacant in the afternoon are being put to use, and consequently a greater number of students can be accommodated.

Several changes have been made in the programs of the various departments, particularly in the electrical engineering program. Engineering chemistry, a lecture course conducted by Professor Schommer, has been shifted from the senior to the junior year. Experimental engineering has been advanced one semester in the program, and is now given in the last semester of the junior year and the first semester of the senior year. Many of the senior electricals are substituting radio, a five hour a week course, for surveying and senior drawing.

Under the new semester-hour system, grades are determined by the number of hours spent in the study of the subject as well as the quality of the work. This is a fairer and more accurate method of determining the actual ability of the student, as heretofore grades have counted the same in all subjects, regardless of their importance or difficulty and the time spent in their study.

Desire to Live

John Edward Allen

I would not have my life be one of bliss—
Untouched by heart-ache, agony, despair—
A pale, anemic thing. My nightly prayer
Is that with each new day I shall not miss
High venturings, nor undeserve the hiss
Of envious human moles who never dare
To touch off rockets in their souls and flare
Above their deepening grooves.

O grant me this:

That I shall scale Life's peaks, explore its glooms,
Know mountained ecstasies, deep-valleyed pains—
That when my last red sands by Time are sieved
And Fate has struck my sinews from her looms,
I shall have earned three words o'er my remains
Besides was born and died—
Between he lived!

THE ARMOUR TECH NEWS

During the latter part of the preceding semester, a movement was started for the publication of a weekly newspaper at Armour. The first editions, five in number, were highly successful, and especially to be commended considering the short time in which they were prepared.

This year John Hommes, as editor-in-chief, with the able assistance of a well organized staff, has been busily at work since the first day of school, when the first edition of this school year was distributed to the student body. At present the Armour Tech News has about 650 subscribers with efforts being made to reach a 100 per cent student body subscription.

The following men assist Mr. Hommes in the preparation of the weekly:

Editorial Staff

Desk Editor.....Fred B. Farrell, '29
News Editor .....David T. Smith, '30
Department Editor...Charles E. Morris, '30
Assistant.....Walter J. Ehrmeyer, '29
Social Editor.....John E. Tarman, '30
Athletic Editor.....John P. Edstrand, '29
Assistant.....Walter Paradzinski, '30
Feature Writer.....Joel M. Jacobson, '29
Faculty Advisor...Prof. Walter Hendricks

Business Staff

Business Manager...Russel E. Johnson, '29
Assistant.....Thomas R. O'Malley, '30
Advertising Manager...Stanley Beatty, '30
Assistants .....Morris O. Nelson, '30
Wilbert B. Deering, '30
Circulation Manager..Preston E. Heath, '30
Assistant.....John W. Gamble, '29
Exchanges.....D. G. Garen, '30

Contributions are also accepted from members of the student body.

THE CYCLE

The staff of the 1929 Cycle has been completed, and is already hard at work in an effort to finish the annual before Circus Day, which will come in the latter part of May, 1929. B. W. Hindman is in charge of the preparation of this year's annual. The remainder of the staff is as follows:

Associate Editor.....P. E. Heath, '30
Art Editor.....D. Banta, '30
Photography.....P. Kjellgren, '31
Social Editor.....J. H. Tschudy, '30
Fraternities.....R. E. Kilbourne, '30
Athletics.....E. B. Ross, '30
Organizations.....B. Dudley, '30
Business Manager.....E. P. Boynton, '30

AT a meeting of the Chicago section of the American Chemical society, held September 28, 1928, Prof. B. B. Freud, associate professor of organic chemistry, was installed as chairman for the coming year. Professor Freud has been an active member in this society for some time. Dr. S. L. Redman, the retiring chairman, delivered the principal address of the meeting entitled *The Tools of the Chemist*, in which he compared the laboratory of the medieval chemist with the workshop of the present day scientist.

NEW INSTRUCTORS

Several new instructors have been added to the faculty since the close of last semester. Mr. Herbert Ensz, of the civil engineering department, is teaching surveying, graphics, structural engineering, and other associated subjects. He is a graduate of the University of Colorado and a man of considerable practical experience. Immediately after graduation he participated in an extensive building program of the University. Since then he has been employed in the Design and Building Division of the Illinois Central Railroad, and with Holabird and Root, prominent architects and engineers. Just before coming to Armour he was a structural engineer on the Board of Local Improvements in the City of Chicago.

The mathematics department has secured Mr. H. W. Haggard to take the place of Mr. Hansen. Mr. Haggard received his Bachelor of Science degree at Denison University, where he was a member of Delta Phi fraternity.

The architectural department, located at the Art Institute, has three new instructors, two of whom are graduates of Armour. Mr. A. Deem, a graduate of Columbia University, who at one time received an award of the American Academy of Rome, is a critic in senior design. Mr. W. L. Suter, an Armour graduate of 1923, is freshman instructor. Mr. J. E. Petersen, of the class of 1926, is one of the sophomore-instructors.

SCHOLARSHIP STATISTICS

Second Semester, 1927-28

The number of students in attendance was 748. The average of all students was 86.7 per cent.

	Per cent	Rank
Senior class	88.3	1
Junior class	87.5	2
Sophomore class	85.8	3
Freshman class	85.6	4
Highest senior	96.5	3
Highest junior	96.8	2
Highest sophomore	94.8	4
Highest freshman	97.5	1
M. E. department	87.2	3
E. E. department	86.9	4
C. E. department	86.0	5
Ch. E. department	87.7	1
F. P. E. department	87.4	2
Arch. department	84.8	6
Tau Beta Pi	93.3	1
Eta Kappa Nu	92.3	4
Phi Lambda Upsilon	90.5	6
Salamander	92.4	3
Chi Epsilon	92.0	5
Pi Tau Sigma	92.6	2
Beta Psi	88.9	1
Triangle	87.9	2
Kappa Delta Tau	87.5	3
Phi Kappa Sigma	87.3	4
Sigma Kappa Delta	87.0	5

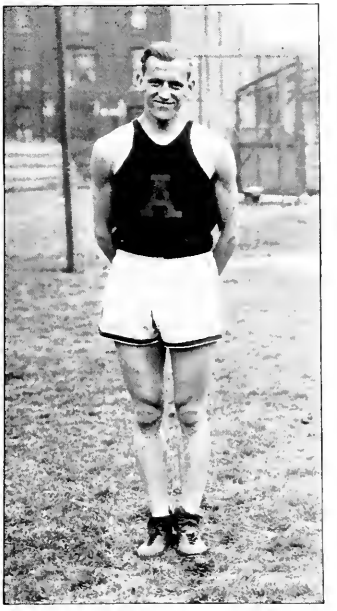
OUR VARSITY CAPTAINS

Track

James Kara, '29

Jimmie Kara, a senior civil, is captain of the track team this year. A star in the hurdles, he has already won three major "A" letters for work on the track team, and is expected to spur the rest of the boys on to victory this year.

Born in Chicago on Dec. 17, 1907, he attended grammar school here and later entered Harrison high school, where he won letters in baseball, football, and track. Having moved to that renowned suburb,



James Kara.

Cicero, he finished his high school course at J. Sterling Morton, where he also won letters in football, baseball, and track.

Seemingly dissatisfied with the number of awards he had won, he came to Armour in 1925 and continued his accumulation of letters. As a diversion from these strenuous labors, he has attended classes and lectures offered by the civil engineering department.

Kara is a member of the Western Society of Engineers, and the Honor "A" Society, being president of the latter.

CLASS OFFICERS ARE ELECTED

The election of officers for each of the four classes of the student body was held during the second week of this semester. The senior and junior officers were elected with little difficulty, because of their excellent organization prior to the elections. The sophomore and freshmen elections were scenes of much confusion, in which the officers were finally elected after a series of meetings.

The following men are the class officers for the scholastic year 1928-29:

Senior class:
- F. H. Juergenson.....President
- E. A. Lawler.....Vice President
- A. J. Stalbovitz.....Secretary
- O. Pinsof .....Treasurer
- C. H. Johnson.....Social Chairman

Junior class:
- M. Vandervelde .....President
- N. D. Buehling.....Vice President
- W. Haffner.....Secretary
- J. Bechtold .....Treasurer
- R. Serson.....Social Chairman
- F. E. Sandborn.....Sergeant at Arms

Sophomore class:
- T. Schueler .....President
- R. Timmerman.....Vice President
- P. Kjellgren.....Secretary
- H. A. Bailey.....Treasurer
- E. J. Stehno.....Sergeant at Arms

Freshman class:
- J. Laden .....President
- J. Ackerman.....Vice President
- L. Billings.....Secretary
- W. L. Edmonds.....Treasurer
- D. Chapman.....Social Chairman

PI TAU SIGMA

The Armour chapter of Pi Tau Sigma, national honorary mechanical engineering fraternity, was host to delegates of twelve other chapters at the annual convention of the organization, held here Friday and Saturday, November 2 and 3. George H. Smith, '29, president of the Armour chapter, presided over the conclave. Ways and means of promoting the welfare of the society was discussed, and a number of changes in the constitution and by-laws were made.

The feature of the convention was the initiation of six members, G. C. Olson, H. C. Newman, A. E. Neumann, E. R. Rowley, C. G. Anderson and H. W. Faulstich, into the local chapter. At this banquet and intiation held at the Illinois Women's Athletic Club, Ernest Hartford, national secretary of the A. S. M. E., was initiated to honorary membership in the fraternity.

The visitors were lodged at the Phi Pi Phi house during the convention, and were entertained at the Chicago-Pennsylvania football game at Stagg Field by the convention host.

The enrollment for the first semester of the college year 1928-1929 is as follows:

	Seniors	Juniors	Sophomores	Freshmen	Specials	Total
Mechanicals	22	27	41	57	1	148
Electricals	47	46	45	52	..	190
Civils	24	26	39	44	1	134
Chemicals	16	17	26	30	3	92
Fire Protects	24	30	28	23	..	105
Architects	14	37	45	61	4	161
Total	147	183	224	267	9	830

ALUMNI NEWS

African-American Radio Contact, by Harrower, '27

The first intercontinental radio connection for commercial use between Africa and America has been established by J. C. Harrower, '27, a graduate of the civil engineering department. He is employed by the Firestone Rubber Company as an engineer at their plantation in Liberia.

The station was designed and built by Mr. Harrower, being assisted in the construction by thirty native laborers. It is located on the Du River about 53 miles from Monrovia, the principal city of Liberia. The station uses from 200 to 5,000 watts on wave lengths from 5.35 to 16.6 meters, and 28 to 52.6 meters. The company broadcasting is done between 12 and 1 o'clock in the morning, and press reports are received from New York about 6 o'clock in the morning. Programs from this city are received through WGY, KDKA, and WEAF.

The Firestone plantations cover 100,000 acres, of which 15,000 acres have been planted with rubber. There are 118 members on the American staff, and 15,000 natives are employed. The use of radio communication will materially aid in speeding up operations. Mr. Harrower has a contract for eighteen months' foreign service.

FRANK B. URSON, '09, DROWNS

Frank B. Urson of Hollywood, Cal., a motion picture director for Cecil De Mille, lost his life last August while swimming in Indian Lake, 14 miles north of Niles, Mich. Mr. Urson was supposedly seized with a heart attack as he dived into the lake from a springboard. He did not reappear above the surface and his 11-year-old daughter summoned nearby bathers to her aid. The body was recovered a few minutes later. Mr. Urson had arrived in Niles at 3 o'clock the previous afternoon to visit his brother-in-law, Dr. John Shallenberger of Chicago, whose farm, White Oaks, is a few miles from Indian Lake. Shortly before 6 o'clock he and his daughter went to the lake for a swim.

The movie director was formerly a Chicagoan, having been graduated from A. I. T. in the department of civil engineering in 1909.

Robert E. N. Marks, '19, has left the employment of the American Steel & Wire Co., where he had been assistant works engineer. He has gone into business for himself as an industrial engineer with his office at 4403 Sheridan Road. His work includes production methods, stock cost investigation, cost reduction, and industrial control, and regular design used in maintenance and construction in the engineering field.

Frank C. Duennec, '21 M. E., is at the Northwest Station of the Commonwealth Edison Company, where he is the assistant boiler room engineer. (He navigates in a new Packard?)

George A. Crapple, '28 Ch. E., is now employed in the laboratories of Wilson & Co., doing research work in their meat packing business.

WHEN DOES THE ENGINEER MARRY?

An attempt to answer this question is being made by a special committee of staff members of the ENGINEER. It is hoped that the results of their survey will be available for an early issue. In the meantime we present some of the data they have already collected.

On August 4 of this year Earle G. Benson, '25, was married to Ruth M. Yount. After completing the m. e. course, Benson qualified as a designer in the bridge department of the Department of Public Works, and is still holding down that position.

Thomas Michels, '22, recently joined the ranks of the Benedicts. He is living in Irving Park, and has given the name Michels to two newly born progeny. He is now engaged in telling Graham, Anderson, Probst & White how to build the new Chicago Opera House.

William H. Vickers, '24, now represents the American Roof Truss Company at 5 North La Salle Street, Chicago. After graduating he was employed by the Underwriters' Laboratories for a few years, where he met his wife. They are living at 6441 St. Anthony Court, where they enjoy many a pleasant comic performance by their first present from the stork.

An announcement from Loomis, Nebr., states the Eldora M. Linder was married on August 5, 1928, to Leslie L. Swartz, '24. They have taken up their residence in Chicago, where Swartz is employed by the Illinois Bell Telephone Company.

And still another alumnus decided to settle down and choose a wife to be his progressive incentive. On June 19, Edward J. Schaack, '23, married Pauline C. Shutter. After their honeymoon they took up residence in New York City, but have since returned to Chicago to live.

But Dan Cupid is just as active among the more recent graduates. Among those who have succumbed are Arthur H. Everly, '28, who is now with the General Electric Company at Schenectady, and Arthur W. Henry, Jr., '28.

Mr. Henry and Miss Margaret Heffernan, who for the last few years had been assisting in the library of the Institute, were married on August 18. They are now living in Dayton, Ohio, where Mr. Henry is employed by the Ohio Inspection Bureau.

The race between Everly and George Kleinert, Jr., '28, to see who would be married first, was at first thought to have been won by Everly, who was married a few days after commencement. But we now understand that Kleinert and Miss Bertha Roalstad were married on January 21 last. Whether Everly will choose to call this unfair competition or not will be learned when the news penetrates the clouds surrounding Schenectady.

Those of us still within the fold will be pleased to learn that the title of "Dean of Married Men," so long held by G. C. Olson, '29, is now claimed by "Herb" Steir, '30. The claims of the rival contestants are now being investigated.

E. W. McMULLEN RESIGNS POSITION AT SIMMONS

Earle W. McMullen, '09, who for several years has been technical director of the Kenosha plant of the Simmons Company, has resigned that position to become general manager of the E. J. Burke Company, a Fond du Lac firm manufacturing steel radiator covers and humidifiers. He will become a member of the firm and will take charge of its plant there. This industry was established four years ago and has been singularly successful. It is engaging on a program of expansion to meet the growing needs of its business.

Mr. McMullen came to Kenosha in 1913 as chemical engineer for the Simmons Company. He graduated as an honor student from A. I. T. in 1909, and for several years taught chemical engineering at the

Institute. At the Simmons Company he rapidly advanced to chief of the department in which he was employed and for a number of years has been technical director of the Kenosha plant. He was a member of the Simmons Round Table and had been active in its work.

Kent Parker, '28, when last heard from, was bound for points west of the Pacific. Kent, who was, among other things, the editor of last year's Cycle, and "Mac" Horn, '28, were again seized with the wanderlust about commencement time and determined to travel to the Orient. Their departure was not immediate, however, for Parker had to undergo an operation for appendicitis early in the summer.

However, the two finally set out for the west coast in a dilapidated flivver. There they found a great scarcity of positions aboard the ocean liners. After trying to land anything from cabin boy down to what have you, Kent finally bulldozed a captain into believing that he was a young sailor and secured a job as a "wiper" in the engine room of the Matson line ship, "Golden Rod," bound for Australia.

Horn was not as successful as Parker, and returned east, stopping off in Chicago several weeks ago for a few days.

We confide to our readers that we have sinister thoughts of waylaying Kent when he returns and making him write an account of his travels for the ENGINEER.

A recent issue of the Byllesby News contained the announcement that Walter G. Jens, '10, has been made manager of the Pittsburgh branch of the Byllesby Engineering and Management Corporation. He had previously been acting manager of the same branch.

Carl H. Otte, who graduated from the mechanical engineering department in '26, has attended Massachusetts Institute of Technology for the last two years, and was awarded his degree of Mechanical Engineer on June 5 of this year.

John W. Heimaster, '28 Ch. E., was last heard from in Charleston, W. Va., where he war working for the Union Carbide and Carbon Company.

Orien M. Spaid, '24, manager of the fire division for the D. Sherman Ellison Insurance Company, spoke at the annual convention for the National Association of Insurance Agents, held at West Baden, Indiana, on Sept. 18, 19 and 20. His discussion was on "Necessary Production Knowledge," and dealt in the main with methods used in determining fire rates.

William W. Kerr, Jr., '28, is inspecting bridges for the Chicago & North Western Railroad in northern Wisconsin. He graduated in the civil engineering department last June.

E. O. GRIFFENHAGEN

An unusual honor to be conferred upon any man who is interested in civic affairs is to be elected President of the national body of the Better Government Association. This achievement was attained recently by Edwin O. Griffenhagen, '06. This news did not come as a surprise, since Mr. Griffenhagen has been a prime mover in several activities of general local interest. The principal of these was the development of a Chicago Government Plan for the Chicago Institute of Local Politics, which was organized during the summer of 1927 for the purpose of discussing the problems of local government in Chicago and the local metropolitan area.

At one of the meetings of the Chicago Institute of Local Politics, a formal resolution expressed its belief that a plan for a permanent government planning commission of citizens of the Chicago region

E. O. Griffenhagen.

should be worked out as soon and as fully as possible. Mr. Griffenhagen was made chairman of a committee on permanent organization with the duty of outlining the organization structure of such a planning commission. In this capacity he worked diligently in preparing a constitution for the Government Planning Association of Chicago and the Metropolitan Area which was adopted at a meeting of the Institute on January 16, 1928.

In the Congressional Record of the Second Session of the Sixty-ninth Congress, one can learn of other meritorious works of Mr. Griffenhagen. He was Chairman of the Committee on Organization of Federal Public Works whose members were all men high up in their professions with national reputations in engineering and research.

Another one of Mr. Griffenhagen's most successful activities has been in the affairs of the Chicago Civil Service Association, an organization founded in 1882. He is the present President of the association, which numbers among its officers and directors many of the prominent men and women of Chicago.

It is a great source of pleasure to the Armour Institute to reflect on the success of those who have received their start in life after mastering their engineering at the Institute. Especially meritorious are the tributes to be paid to those who have been successful and have attained such in a quiet unassuming manner as has Mr. E. O. Griffenhagen. His interest in civic organizations was forecast years ago when he served as president of the Alumni Association of Armour Institute of Technology.

HONORED ARCHITECT DIES

Horace Sweet Powers, '99, died on Sept. 2, in Lansing, Michigan, after a long illness. He was fifty-six years old and unmarried.

He graduated from the architectural course of Armour Institute in 1899, and later from the Art Institute. He was architect of the United States commission to the Paris exposition in 1900. Later he entered business for himself in Chicago. In recent years, however, he had made his home in Lansing, and was a member of the firm of Warren, Holmes, Powers Company in that city.

Clarence F. Kantz, '24, is working for his Ph. D. degree in chemistry at the University of Pittsburg.

Irving B. Leuth, '28 E. E., is pursuing a course at the Central Station Institute, and has been sent to University of Wisconsin to further his studies.

F. D. Payne, '28, has been increasing his knowledge of the state of Wisconsin, being employed by the Wisconsin Inspection Bureau.

Besides A. H. Everly, other '28 men with G. E. at Schenectady include L. J. Anderson, L. J. Ericsson, and M. B. Tracy.

Walter J. Zenner, "Ye Ed" of last year's ENGINEER, reports that he is in good company at the Morkrum-Kleinschmidt Corporation, Chicago. Others entertaining hopes of some day stepping into the shoes of Howard L. Krum, '06, vice president of the company, are H. T. Dahlgren, '28; C. W. Burcky, '27; E. S. Larson, '25, and R. Schuler, '27. A. S. Benjamin, '17, is a sales engineer for the company.

Word was received some time ago that Mr. Einar Enander, '06, underground engineer for the Public Service Co. of Northern Illinois, had gone to Europe to study the practices in underground construction there.

World's Largest Telescope Constructed by Armour Tech Alumnus

Francis G. Pease, who received his B. S. in C. E. in 1901, his M. S. in 1924, and a D. Sc. degree in 1927, has been instrumental in the construction of the largest telescope in the world. Mr. Pease is working at the California Institute of Technology on this telescope.

The California Institute has announced that this new telescope will be twice the size and have four times the power of the largest telescope now in use which is located at the Mount Wilson Observatory. The new telescope will have a 200 inch reflector.

With this telescope it will be possible to explore many island universes beyond the Milky Way. At present but two or three of these are known to any degree. The use of this new telescope will probably give us much information about spiral nebulae and our own universe of which our sun with its encircling planets is but a small part.

THE ROOT OF TECH.

IT'S "SQUARE."

With pen and with pencil we're learning to say
Nothing, more cleverly, every day.—William Allingham

FROM THE COLLEGE SONGSTER TO HIS GIRL

Dear old pal:

Girl of my dreams, I told them all about you, and without you, sweetheart, in the evening and at dawning I'm all by my lonesome, and who wouldn't be blue.

Last night, under the moon, me and my shadow were thinking of you. Beautiful, are you thinking of me tonight? Wherever you are or when you're with somebody else, d'you love me? Promise me that you will remember always that kiss in the dark and that some day, some time, in a shady nook under a shady tree, you'll kiss me again.

Sweet Sue, did you mean it when you said "I love you?" Didn't I tell you I'd do anything to make you happy? We'll have a cottage small by a waterfall with four walls, or together we two will travel the vagabond trail, having our ups and downs, for highways are happy ways.

Mine, all mine. If I could only call you that. Some day, baby, maybe I'll baby you.

Till we meet again.

—E. Schmitz,
Wash. U., '31.

Teacher: How old would a person be who was born in 1890?

Willie: Man or woman?

Speaking of dentists, they leave the larger cavities to be filled by professors.

ECONOMY

When college students commit suicide, they usually shoot themselves in the chest. They're dead from the neck up already.

With winter coming on, the movie stars will turn again to their indorse sport.

THESE STURDY ENGINEERS

"You going to eat?"
"Yea, wher'll we go?"
"Oh, let's eat up the street."

Pledges here, pledges there,
Pledges, pledges everywhere.
Soon the paddles will be made,
Upon the pledges they'll be laid.
No pledges here, no pledges there,
No pledges, pledges, anywhere.

"ANSWERED AT LAST"

—For the same reason that you can get a red nose from purple grapes.

The government officials of Chicago are usually elected by the secret bullet.

FAILURE AND SUCCESS

Genius, that power that dazzles mortal eyes,
Is oft but perseverance in disguise.
Continuous effort in itself implies,
In spite of countless falls, the power to rise.
Twixt failure and success the point's so fine,
Men know not when they touch the line.

As the tide goes clear out, it comes again clear in.
In business 'tis the wisest men who win.
And oh! how often when shades of doubt, dismay,
With little more persistence, courage, vim,
Success will down o'er fortune's cloudy rim.

Then take this honey from the bitterest cup.
There is no failure save in giving up.
No real falls, so long as one still tries,
For seeming setbacks make the strong man wise.
There is no defeat, in truth, save from within.
Unless you're beaten there, you're sure to win.

Many surprises should be at hand if one would try the electrolysis of clam chowder for slams. It would be like finding the radius of curvature of a bullion cube.

Seniors are made for great things,
Sophs and juniors for small;
But what gets me thinking is
Why freshman are made at all.

THAT'S POVERTY—

Having to pawn your false teeth so you can get money to buy something to eat.

—Judge.

All new saxophonists are on the verge of being finished musicians the very first time they practice in an apartment building.

MODERN VERSION

Father (to small daughter who has come back from Sunday school with an illustrated text-card in her hand): "What have you there, my dear?"

Daughter: "Oh, just an ad about heaven."

THE YOUNGER GENERATION

As there was no colored church in town, the young inksplash was brought before a certain reverend to be baptized. Mose very solemnly said he wished his baby to be named *Electricity*.

"Don't you think that's a rather unusual name?" exclaimed the pastor.

"Well, suh," replied Mose, "us niggers figgered this way. Mah wife's name am Dinah, and mah name am Mose, an' Dinah-Mose done make electricity—so dere you am."

"What do the three balls in front of a pawnshop mean?"

"Two to one you won't get it back."

A HANDICAP

Frosh, reading Caesar: Begone——

Professor: Why is there a pause after begone?

Frosh: To give him time to run.

A fund is to be started soon for the purpose of purchasing a new suit for the Cartesian Diver of Science Hall. It is said that he came over to this country before the passage of the present immigration laws. Incidently, he has heard more dry jokes during his career than any other piece of apparatus used during a physics lecture course.

A FRIENDLY ENEMY

Irate Father: "I'll teach you to kiss my daughter!"

The reason that they whitewash chicken coops is to keep the hens from eating the grain in the wood.

BUDDING INVENTOR DISCOVERED AT A. I. T.

Armour men frequently become world-famous after their graduation, but seldom do they achieve fame while still at school. But at last we have such a one in our midst; B. H. Roffee has done the deed, for as coffee has its grinder, so Roffee has his *Hopochine*. It is a widely discussed invention, and it is said to be an initial step in his life's great work of giving the world a successful and useful external combustion engine. By special arrangements with the inventor, we are able to give to our readers some first hand information of this great machine, a feature of which is the use of molasses as an anti-knock compound.

The Hopochine

The Hopochine is a mechanized pogo stick, with a one-cylinder, two-cycle internal combustion engine as the source of power.

The cylinder head, with the carburetor on one side, and the spark plug and ignition system on the other, is of one piece, machined to size. The casing below that is bolted on, and in it is the large coil spring which is compressed when a weight is put on the Hopochine. It is the recoil of this spring that causes the hop before the firing position is reached.

The timing is so arranged that the piston must be forced full to the top of its stroke, against the spring previously mentioned before the charge in the cylinder will be ignited.

The exhaust gases are discharged through an exhaust pipe which is extended to the base of the machine so the gases will not bother the operator. Mr. Roffee is contemplating a special model of his Hopochine for winter use, in which the sensible heat of these gases may be used to reduce the discomforts of winter travel.

The interior of the cylinder is similar to an ordinary engine, with its exhaust and intake valves, and standard 7/8-inch spark plug, and one compression and one oil ring on the piston.

At this point the similarity ends, for instead of the conventional wrist pin and connecting rod, the piston is connected rigidly to the rod which bears the thrust. The direct blow of the piston when the explosion occurs would be too severe, so it is damped by means of a flare in the end of the thrust rod, into which a smaller shaft is inserted against the force of a strong coil spring. This smaller shaft is directly connected to the chuck which comes into contact with the ground.

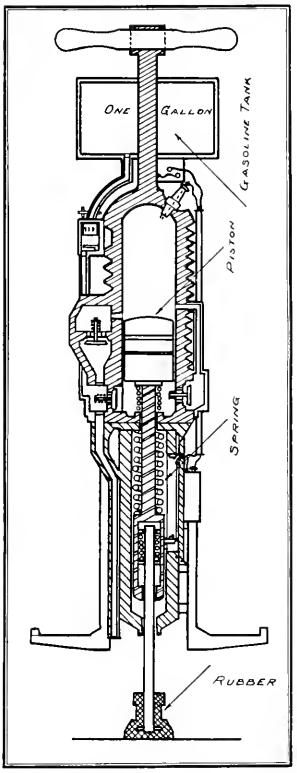
The supports on which the operator stands are fastened on the side of the rod case, as well as on the cylinder head proper.

On the upper end of the machine is the handle by which the operator controls the machine. Directly below that is the gasoline tank of a one gallon capacity. The operating handle incorporates a gas and spark control, and bears a marked similarity to the controls in use upon motorcycles. The spark is utilized only when starting the machine; after it has been used for a short distance, the compression becomes sufficient to ignite the fuel charge upon its injection. The efficiency of this cycle of operation can readily be compared with that of the Diesel engine.

Method of Operation

The machine is gripped firmly by the handle, and held either vertical or inclined slightly forward. The operator puts one foot on one of the rests, and steps up on the machine with the other foot. The operator's weight pushes the piston up into the cylinder against the spring which immediately forces it out again, causing the machine to hop.

By shifting his weight and controlling the inclination of the machine, the operator may readily control the length, height and direction of the hops. It is possible to remain steadily over one spot of ground, merely hopping up and down, and this feature is of great value when touring, as it is possible to read the signs on direction posts without the necessity of climbing them.



The Roffee Hopochine.

As soon as the force of the operator on the machine is sufficient to push the piston to the top of its stroke, ignition will take place, and from then on the management of the Hopochine is a matter of little effort, though of some personal ability.

Specifications

Height—3' 6" from handles to foot rest.
Weight—85 lb. with full fuel tank.
Speed—0 to 24 kilohops per hour.
Mileage—40 miles per gallon at average speed.
Cylinder dimensions—3.50"x3.75".
Angle of inclination—90 to 60 degrees with horizontal.

"Shay, offisher, where can I find Michigan Boulevard?"

"Why, you're standing on it!"

"No wonder I couldn't see it."

ONE TURN OF THE DIAL

They're off! They're going around the bend just as Battling Riley stops another left with his jaw. Again he winds up, and throws. It misses the peg and goes in for a ringer. They're lined up now for the kick-off, but the ball rolls off the hoop for two points. The game is on ice, so the puck is served into the net, making the score thirty-love. Once more they meet; a half-nelson and all will be over. But he regains his strength and forges ahead to win by a yard.

A popular parachute maker has joined the billboard advertisers and now will refund your money if the parachute fails to open.

TABLOID

Princess Flies Atlantic Ocean
Twenty Killed in Subway Crash
Gangster Shot in East Hoboken
Wifey Poisons Hubby's Hash!

Three Found Dead in Orchid Love Nest
Peggy's Husband Takes the Count
Girl Burns Self in Ancient Love Test
Prince of Wales Falls Off his Mount!

Clerk Embezzles Million Dollars
Baby Burglar Shoots Up Cop
Girl Traps Bandit With Her Hollers
Police Seize Truckloads Full of Hop!

Mussolini Speaks of Freedom
Feeds His People Castor Oil
Drys Find Kegs of Ancient Bay Rum
Aid for Tillers of the Soil.

Chicago Passes Quiet Sunday
Robber Tortures Girl with Snuff
Volstead Act Enforced One Monday
Now We Hope You've Had Enough!!

Mm By Gosh.

They'll never print what the blindfolded cigarette smoker said when he put the wrong end in his mouth.

The reason that they cheer when a football player is hurt is so the women can't hear what he may be saying.

First Student: "I never had trouble with Latin."

Second Ditto: "How come?"

First Ditto: "Why, I never took it."

If all the professors were placed shoulder to shoulder, they would reach more than half way across Lake Michigan. There are many who would like to see the statement proven.

Soph: Why, you little imbecile!

Frosh: Watch out! Nobody can call me little and get away with it!

If the average college student is said to have no brains, what have half of them got?

"Papa! Buy me a fur coat?"

"A pelt I'll give you!"

. . . with their feet on the ground . . .

Please mention The Armour Engineer

THE WORLD'S LARGEST PUMPING STATION

(*Continued from page 7*)

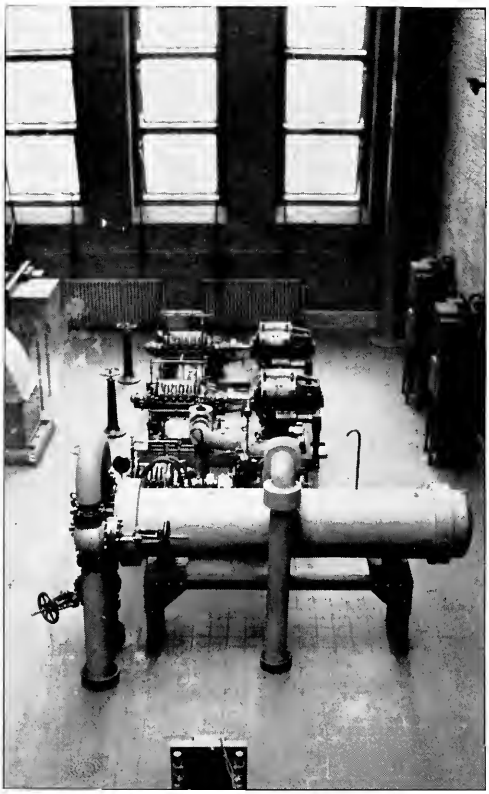
usual dosage of chlorine is four and one-half pounds per million gallons of water pumped.

The circuit of the steam in this station is also of interest. Leaving the boiler at a pressure of 315 lb. per sq. in. and a superheat of 225 degrees fahr., it passes to the turbines. From them it is exhausted into the condensers from which the condensate is pumped to the feed water heaters by means of water powered pumps.

At the heaters is located a float valve which regulates the amount of water in them. In the event that the load on the station is low, and little water is required by the boilers, the float valve operates to by-pass the condensate to reserve tanks where it is stored until needed. If the water is needed in the boiler, it then passes from the heaters through the feed water pumps, through a condenser in which it acts as cooling water, and into the boilers. When the load increases, water that has been stored in the reserve tanks is pumped into the feed water heater, from which it follows the same course to the boilers.

In spite of this system of storing and re-using the condensate from the turbines, it is found that from two and one-half to seven per cent of make-up water must be supplied to take care of losses. This water is distilled before being used in the boilers. It first enters the preheater, which is a small open type heater. From the preheater it is pumped into a two effect evaporator, the first effect of which is heated by steam bled from the main header. The water evaporated from the first effect serves as the steam supply to the second. From the second effect of the evaporator, the vapor passes into the condenser in which the boiler feed water is acting as the cooling water. By this means the new feed water is freed from all impurities. By using the feed water to the boilers as the cooling water in the condenser for the new feed water, loss of heat is avoided, except the negligible loss due to radiation. All feed water supplied to the boilers is metered through a four inch Venturi tube.

The William Hale Thompson station has, to a great extent, avoided the use of steam driven auxiliaries. To do this, the station generates its own power. Each generating unit, of which there are two, consists of a 200 kw. turbo-generator running at 5000 r.p.m. Either of these units is capable of supplying the demand of the various motors in the station, which total 120, and which range in size from ½ to 75 hp. These turbo-generators run non-condensing with a back pressure of 2 lb. per sq. in., the exhaust being used for heating purposes, although steam may also be bled from the interstage connection on the pumping units for this purpose.



Condenser and Battery of Steam and Electric Feed Water Pumps.

The largest demand on the generators comes from the feed water pumps, which include three centrifugal pumps, two of which are electrically driven, and one of which is steam operated and is held as a standby. Any one of these pumps is capable of supplying the feed water under normal load conditions on the station. These centrifugal feed water pumps are able to pump 200 gallons of water per minute against an 810 foot head.

The main unit condensate pumps are water-motor driven, with electrically driven pumps as standbys. In event of a failure of the generators, it is still possible to keep the units in operation.

The station is equipped with four Edge Moor four pass boilers, rated at 600 hp. each, and normally operated at 150 percent rating. Any two of these boilers will carry the normal load of the station, which consists of three of the pumping units with the necessary auxiliaries.

The boilers are equipped with Bailey meters and Carrick controls operating on the draft and the stokers, which are of the underfeed type. Foster superheaters are used between the first and second passes of the boilers, and the feed water is automatically controlled by a Cope's regulator. These boilers have shown on official test an overall efficiency of 81 percent.

Provision is made in the rear of the main building for the storage of from 12,000 to 15,000 tons of coal. A spur track runs through the center of this yard, and the coal is directly dumped from the cars. When it is to be used, it is picked up by a clamshell bucket which loads it into a car. This car is then brought to a hopper located above a crusher and the coal is dumped. The crusher, of the hammer type, crushes the coal to pass a three-quarter inch mesh. This crusher has a capacity of 75 tons of coal per hour. From the crusher the coal is lifted by a conveyor to three 200 ton overhead bunkers. As the daily consumption is about 110 tons, the supply in the bunkers will enable the station to run from four to five days in event of a break-down in the coal supply. Coal is carried from these bunkers to the Taylor underfeed stokers by means of a coal larry of two tons capacity.

Ash is fed from the boiler hoppers into small cars which carry it to a skip hoist which automatically raises the ash and dumps it into a hopper. From the hopper the ash may be removed by railroad, or as is usually the case, it is used by the street repair department of the City of Chicago.

The author is indebted to the City of Chicago for the assistance given him in the preparation of this article.

CHROMIUM PLATING

(*Continued from page* 15)

sen is most generally used, and consists essentially of making the metal to be plated the anode in a bath of sulphuric acid of 66 degrees Baume gravity before plating. Alternating or direct current is used and the current density usually used is 25 to 60 amp. per sq. ft. At first appearance, the above layout gives one the impression of being either a pickling bath or an electrolytic cell, but it is neither of these. It is not a pickling bath because it removes deeply imbedded foreign materials and other material not ordinarily removed by pickling; nor is the sulphuric acid an electrolyte.

It is possible, by this method to successfully degasify in a few minutes all the common metals but aluminum, and if conditions are carefully and properly regulated, a fine etching is produced upon the surface of the metal. The importance of this is that this etching affords opportunity for the surface crystals of the metal to be plated to successfully interlock with the crystals of the plating metal. Chromium plated metals which have been treated in this way before plating have been bent, pressed, and fabricated without scaling of the plating.

The deposit produced upon a plate may vary widely depending upon the conditions of operation, the closeness of control exercised, the kind of surface to be plated, the metal to be plated, (in this case chromium), and the cleaning to which it has been subjected. The nature of its finish, and the conditions of the bath such as composition, temperature and current time also have a bearing. It can be safely said that each different article to be plated presents new problems with the difficulty of obtaining a uniform thickness of deposit on irregular pieces being a common difficulty. This is usually remedied to a great extent by arranging the racks and building the anodes to conform to the shape of the irregular articles. This gives a uniform current density over the whole plate, and thus causes the deposition of a coating of uniform thickness.

K. W. Schwartz has done a great deal of experimental work on chromium plating which has been helpful to both the users of the chromium plate and to the platers themselves. His work is tabulated in the Transactions of the American Electro-chemical Society as follows:

Schwartz's tests on corrosion of chromium plate are extensive although they were made for the most part on a laboratory scale. He found that the exposure of chromium plate for weeks to the corrosive atmosphere of the laboratory had no effect on it, but that iron corroded rapidly in the same atmosphere. He also tested chromium plate in air saturated with vapors of a corrosive nature and his results were as tabulated below:

EFFECT OF CURRENT DENSITY ON DEPOSIT

Sample	Time Min.	Current Density Amp. Per Sq. Ft.	Voltage	Description of Deposit
1	120	90	2.3	Crystalline and Adherent
2	60	45	2.3	Surface Barely Covered
3	120	125	2.5	Very Good, Bright, Adherent
4	120	144	2.5	Gray Crystalline
5	60	345	2.9	Dull, Adherent, Tends to Yellow
6	120	540	3.5	Gray, Turns Yellow and Cracks

TESTS IN AIR SATURATED WITH VAPORS

(a) Ammonia Vapor

Sample	Loss in Gm. Per Sq. Cm. Per Yr.
Copper	Gained in Weight
Iron	0
Cr. on Iron	0
Aluminum	0
Duriron	45

(b) Hydrochloric Acid Fumes

Sample	Loss in Gm. Per Sq. Cm. Per Yr.
Copper	Gained in Weight
Iron	120
Cr. on Iron	1262
Aluminum	377
Duriron	70

(c) Conc. Nitric Acid Fumes

Sample	Loss in Gm. Per Sq. Cm. Per Yr.
Aluminum	19.4
Iron	2290
Duriron	10
Cr. on Iron	11.8
Nu	47.5

(*Continued on page* 34)

COMMENCEMENT ADDRESS

(*Continued from page* 5)

back, gaze into the skies and read there, lettered in the guiding stars, the single word *think*.

A review of the progress of the world for the past wonderful hundred years lists Pasteur and bacteriology; Morton, anesthetics and surgery; Watt and steam; Faraday, the dynamo and our electrical wonders; the world-changing internal combustion engine; the rapid march of chemistry and physics. These are the children of thought.

Someone has said that in coming ages our time will be known as the Age of Darwin, and this because he more masterfully than others, in the face of established prejudice and blinding superstitions, plodded on with a god-like devotion to absolute fact and the purity of truth. He is the great leader of our scientific spirit in the eternal search for cause and effect.

How many of us, from the beautiful lessons of religion and the fairy stories made to idealize our aims, have mistakenly emerged into manhood with the half-conscious conviction that we are fallen angels; that the impurities and ugly inward thoughts measure our degradation, which, if it were known, would separate us from our kind; that our wickedness is the curse from the sins of others descended upon us?

On a class-stone at Culver is carved this sentiment:

> LEST WE FORGET that out of wild nature we are come; that our instincts are great, our wisdom little, that the main current of our will is still like the green moving waters, and our reasoned choices like the flutter of foam on its surface, that we became citizens but yesterday and were bred in the wilderness.

We are not fallen angels! In the dim past we have wriggled from the ooze, crawled slowly on the banks, stood upright among the trees, and now with wings spread we master the air — and this with the power of thought. Our curse is ignorance; our broad highway to godliness is truth; our motor is thought.

This realization of our common human weakness is a great help in our way along. It creates sympathy, and so understanding, patience, and helpfulness. It makes us kind. Perhaps it explains why "one touch of nature makes the whole world kin." If you think, you will thus open wider the door of psychology. If you study yourself, you will learn others. Gradually your intelligence will help to illumine the path on which you have been stumbling and smooth it for those traveling with you. Your relations with others will be the great part of your life so treasure and preserve them and keep them sweet.

Respect the good qualities in those who have won what you wish to attain. Follow eagerly the orders of the captain of the ship which carries you, through calm and storm; safely to your destination. Admire the knowledge which makes this possible, but indulge in no sentimental worship. Do not blind your eyes with unseeing admiration. Do not approach the seats of the mighty in fear: they are but children too, a little more grown. Do not address them with extravagant praise, or you will receive, in their embarrassment, what you have offered in yours—affectation. Do not throw yourself abject at their feet, but sit there erect. Be simple, be natural, be sincere, be thoughtful—and in brotherhood they will reach out a guiding hand and lead you as far as you can go. Believe this, boys. Will not you do the same?

If on the brink of maturity you would gauge the attitude of your elders, *think*—and you will find that for twenty years they have carried youth in affection. The food that nourished him, the clothes he wears, the house that shelters him, the streets

ARMOUR TECH ATHLETIC ASSOCIATION

Treasurer's Report, College Year 1927-28

Receipts		
Cash Balance, September, 1927		$ 3,553.79
818 student fees, $8.50 each, 1st Semester	$ 6,953.00	
Less student adjustments	2.00	
	6,951.00	
Less class dues	816.00	6,135.00
768 student fees, $8.50 each, 2nd Semester	6,528.00	
Less student adjustments	43.50	
	6,484.50	
Less class dues	762.00	5,722.50
Interest on bank balance		293.75
		$15,705.04
Expenses		
"A" Blankets	$ 76.00	
Armour Engineer	$2,354.94	
Advertisements & subscriptions	1,188.45	1,056.49
Baseball	33.07	
Basketball	340.13	
Boxing and Wrestling	57.84	
Cycle	4,248.20	
Adv. sale of books & donations	1,779.00	2,469.20
Directors and Coaches	4,613.00	
General Expense	274.51	
Golf	314.25	
Lockers—Field House	228.00	
Medical Expense	276.00	
Musical Clubs	524.30	
Swimming	233.48	
Tennis	723.65	
Track	650.82	
	11,850.74	
Cash Balance	4,960.13	
Less Class Balance	1,105.83	3,854.30
		$15,705.04

he walks upon, the parks in which he plays, the schools and colleges, the church and the hospitals, are the happy gift of man to boy.

This, though beautiful, is not sentimental. It is intelligent. It is necessary. It must be better done. Who in a few years is to man the ship, and who to captain it? Who is to provide, protect, and educate the youth? Your elders have waited for you. We need you. We extend the arms of welcome, and I bring you cheerful news: it's great fun!—a wonderful adventure—if you think. There are some rough places, some detours.

And now I tell you of a great gift. As the messenger of all America I bring you this great gift. It is opportunity.

Come—and good luck—and God bless you.

UTILITIES AND EDUCATIONAL INSTITUTIONS

(*Continued from page* 8)

quainted them with some of its fundamental problems. It seems reasonable to expect, however, that by following this program a greater number of those who originally enter the employment of the companies will remain with them. This, in fact, has been the experience of the companies who have pursued this policy. The interest of these students has been stimulated, their assimilation has been facilitated and their progress has been speeded up.

The results thus far achieved by the utility companies have been highly satisfactory. Interest has been aroused for a scientific study of the various problems of the industry, and the utility companies have obtained a better selection and a more rapid progress of the students who have entered their employment, since a majority of them have done so with the original intention of remaining on the job and making it their life's work.

MODERN ELECTRIC WELDING

(*Continued from page* 11)

from the electrode onto the work in a straight line, thus making it possible to work successfully overhead or on vertical surfaces. The metallic rod, which is melted as the welding continues, is hard drawn mild steel rather low in undesirable elements.

The use of alternating current in the metallic arc has been suggested and the disadvantage of loss of the hot spot has been noted. A further disadvantage is that greater skill is required of the operator to get a uniform deposit. The efficiency of the welded joint is also decreased. The advantage gained is that the operating costs with alternating current are less, since transformers and reactances may be used. Less capital is required and there is little loss in series resistance. Circumstances entirely govern the decision in such a question.

In passing through the arc the metal in the molten and vaporized states comes in contact with the air. At the temperature of the arc the main elements of air have a strong affinity for the metals in the arc stream. As a result, the formation of oxides and nitrides is inevitable. To overcome this action a sleeve may be put over the arc, or hydrogen may be passed over the weld.

One disadvantage of the metallic arc welding is that the iron arc is very rich in ultraviolet light, which produces sunburn and is very painful to the eyes. A shield is used to protect the operator. That the process imposes a severe nervous strain on the operator is unquestioned by anyone who has seen an arc welder at work. The man must work behind a mask, often in an awkward position, and hold his hand absolutely steady all the time he is depositing metal. This means skilled labor, and even then

there is no certainty that the quality of his work will not slip. Considerable poor arc welding has been done by unskilled operators, but with proper training and supervision, good equipment and proper welding materials, good electric arc welds can be and are made.

DEVELOPMENTS IN HYDRAULIC TURBINES

(*Continued from page* 13)

It is difficult to obtain a real idea of the quickness with which this combined force acts upon the buckets. It has a hammer blow which starts from zero, rises to a maximum of about 164,000 lbs. and then to zero in the exceedingly short period of about 1/33 of a second.

The two 8½-in. diameter jets producing 60,000 hp. under 2,300-ft. head discharge a total of about 285 cu. ft. per second or approximately 130,000 gallons per minute. This flow is controlled by two governors which can stop it completely in 3½ seconds.

Lower head machines, designed for large slow-speed streams, have larger buckets and smaller diameters. The transition from impulse to Francis turbine occurs at about 1,000 feet head. These machines will be described in the next issue of the ENGINEER.

CHROMIUM PLATING

(*Continued from page* 28)

(d) Hydrogen Sulphide Fumes

Sample	Loss in Gm. Per Sq. Cm. Per Yr.
Iron	23.6
Duriron	Gained in Weight
Aluminum	7.1
Cr. on Iron	Slight Gain

The following conclusions were then arrived at: Chromium plating has wearing qualities and hardness superior to ordinary iron, galvanized iron, and tinned iron. Chromium plated iron is not attacked by molten tin, zinc, or brass, whereas ordinary iron disintegrates rapidly under the same conditions.

ENGINEERING NEWS

(*Continued from page* 14)

total penetrating power is estimated to be equivalent to 131 feet of salt water. The rays can penetrate nearly 13 feet of lead, whereas the most penetrating X-rays in use today cannot pass through more than a half-inch. These "aurora" waves are apparently far more penetrating than any other ray known. They are believed to represent a new range of radiation in the spectrum, as far above the X-rays as X-rays are above the frequencies of light waves.

These experiments are of special interest in view of the high penetrating "cosmic rays" recently investigated by Millikan and Kohlhorster. It has been inferred that the rays were of extra planetary origin, but Dr. Smith's experiments seem to suggest that they may be derived from the disturbances caused by the aurora borealis.

—Adapted from *The Illuminating Engineer.*

This Drudgery of Business

"A man of wit is not incapable of business, but above it," sang Alexander Pope, adding that an adventurous spirit was too good to be put to "this drudgery."

Two centuries have passed and the poets of today make the same

indictment. They, too, are misled by the sensitive concern of business men to appear matter-of-fact. We take pains to conceal sentiment behind a mask of materialism. We are shamefaced about the joy of our tremendous job of making the world more comfortable.

Romance in business? Huh! we reply, business is business. Adventure in factory layouts? Poetry in a production schedule? Fascination in a sales quota? Mystery in a balance sheet? Chivalry in buying and selling? Heroics in per cents? Ridiculous!

Yet, underneath the hard-boiled exterior, the successful business man recognizes and enjoys the stirring adventure of which he is a part. For in every stride toward a higher civilization are the romantic figures of resourceful men, who, like great poets, have kept their hands on the present and their eyes on the future.

Roaring cataracts put to the making of light and power. Mountains pierced to give speeding trains right of way. Plant food plucked from the air. The sky made highways of commerce. Nations joined by an eager spark leaping across the ocean. Domestic drudgery assumed by laundry, bakery and factory. Ice by wire, "lumber" from sugar cane, silk from wood. An automaton, handing out merchandise with a "Thank you!" at the drop of a coin. Of such is the true essence of romance!

The quality of poetry is in all fine projects, big or little. "Why, that man Harriman," exclaimed a discerning European, "supposed to be so hard-boiled, that man is a great poet! Only, he rhymes in rails!" Whether the rhyming be with rails, with ships, with sealing wax, with groceries, with dry goods, or what not, the feeling of great poetry is in all honest work that has sincerity and depth of purpose.

The spirit of romance still finds expression in the work-a-day world, and no poetic soul is above the "drudgery of business." Business has its adventurers no less renowned than the trail-blazers and pathfinders of frontier days.

Aready today is in forge and farm and mine and bench and counter.

This drudgery of business! Drudgery of body or mind? Wrong, on both counts. Business is making the very word drudgery archaic.

The case might rest on the abolition of drudgery. That in itself is an adventure too noble to be compressed within Alexander Pope's narrow measure. Its meter is scaled to the magnitude of nature, to the wistful wants of a whole world.

—Adapted from *Merle Thorpe.*

Tunneling the English Channel

England is again reviving the discussion of a submarine tunnel joining Great Britain and France under the English Channel. It is believed there are but few difficulties to be considered except those of finance.

It will be recalled that in 1884 a military and civil committee began to investigate this subject, but as it was thought that such a tunnel would render England more liable to attack from the Continent and would lessen her fairly safe impregnability, Parliament refused at that time to endorse the tunnel idea.

Today the question is being discussed throughout England and eminent engineers believe that "changed conditions" warrant the building of this 26-mile underwater artery which should accommodate automobiles as well as trains. A tunnel linking England to the Continent, since the advent of the air-menacing flying machine, could add but little to her danger of attack from the east, and modern precautions could prevent surprise attacks in case of war, while England's superior navy, with depth bombs and torpedoes, could destroy the tunnel if necessary.

Those favoring the tunnel believe the time between London and Paris would be reduced one-half or more and the present discomfort of two railroad rides and an often turbulent cross-channel boat ride, with the necessary station changes, would of course be largely eliminated. The traveler could get in a non-stop express which would transport him from one capital to the other, without change.

It is undoubtedly true that this tunnel would absorb a considerable amount of England's present unemployment. The financing would be done by the French and English governments, and probably a good deal of the money advanced would have to be made by private capital.

The question is now a live one in London and various interests are expected to meet this month to discuss the tremendous project from all angles. General G. Barker, Colonel Commandant of the Royal Engineers, who was secretary of the Channel Tunnel Military and Civil Committee of 1884 which turned down the plan, now believes the subject should be reopened, and his favorable attitude is reported as typical of the present English view.

—*Engineering World.*

We Never Reach the Goal

Half the fun is dreaming, half is keeping on,
Planning for and scheming till the thing is done;
But when you've achieved it, dull and cold it seems
Not as you perceived it, in your golden dreams.

What is done is ended, you need hope no more,
That which seemed so splendid in the days before
Lies a task completed, commonplace to view—
Just a foe defeated, now there's more to do.

JOY, is in the dreaming, DOING holds the thrill;
Dull the time is seeming while you're standing still.
Pride of conquest stifles all the future fun;
Goals achieved are trifles, greater must be won.

Dark although the day be, joy lies in the doubt,
Hope is in the "maybe you can work things out;"
But the thrill is over when the fight is won,
And you must discover new goals farther on.

—*Edgar A. Guest.*

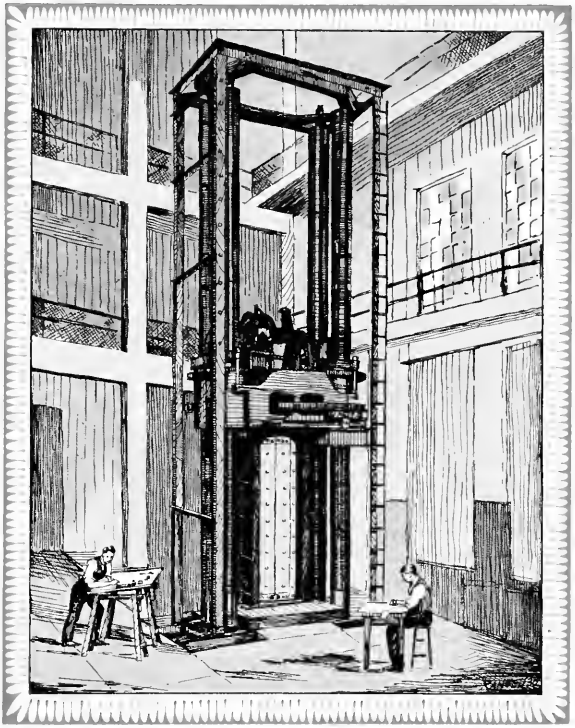
High Voltage Transmission in Canada

The utilization of the highest transmission voltage in Canada has been started with the opening of the new Quebec section between Paugan Falls and Toronto, with operation at 220,000 volts. Twelve transformers for operation at 220,000 volts were supplied to the Gatineau Power Company by the Canadian General Electric Co., Ltd. Nine of these transformers are rated at 19,000 kva., 25 cycles, and step up the generator voltage from 6,600 to 220,000 volts. The remaining three are rated at 20,000 kva., 25 cycles, and will be used to supply power to a 110,000 volt transmission system from the 220,000 volt line. The generating stations of the Gatineau Power Company are approximately 250 miles from Toronto.

—*General Electric Review.*

The ARMOUR ENGINEER

VOL. XX. JANUARY, 1929 NO. 2



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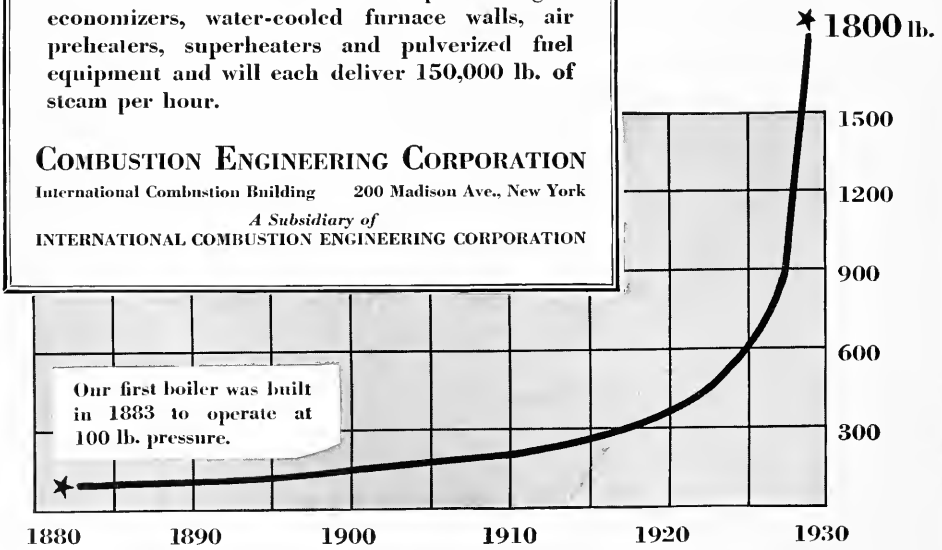

COMBUSTION ENGINEERING

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Volume XX January, 1929 No. 2

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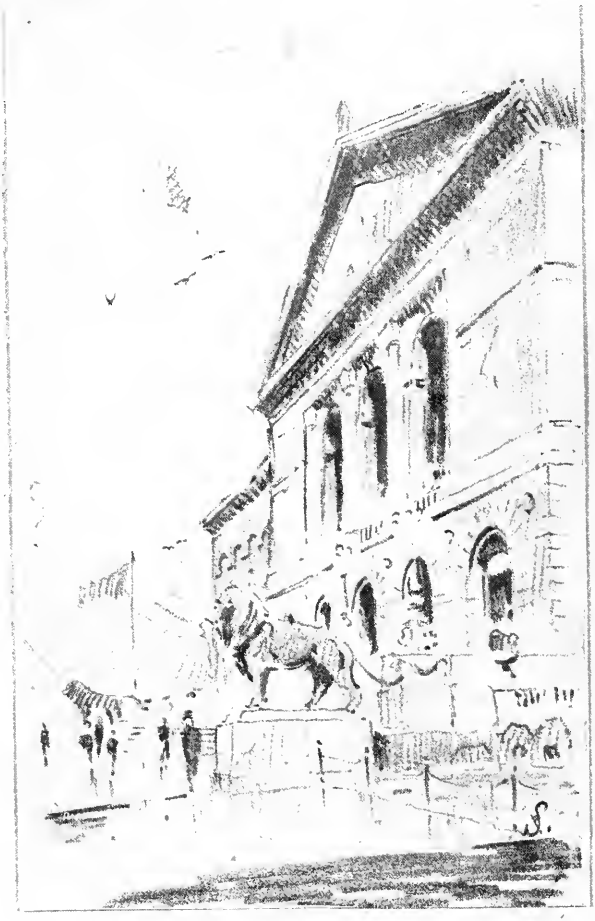
Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.



THE ART INSTITUTE

The
ARMOUR ENGINEER

VOLUME XX January, 1929 NUMBER 2

THE BUREAU OF STANDARDS

By Hugh G. Boutell
Associate Engineer, National Bureau of Standards

THE National Bureau of Standards is one of the great service bureaus of the Department of Commerce. From the nature of its activities it is in close touch with every branch of the Government and with many of our largest industries.

The work includes fundamental research in practically every branch of physics and many branches of chemistry, metallurgy, and engineering. The technologic work includes research on basic problems underlying the use of structural materials of all sorts, the development of improved methods, and the use of new materials and technique. In addition a large amount of testing is performed for the Federal and State Governments and for the public, thus keeping the staff in close touch with the latest developments in commercial work.

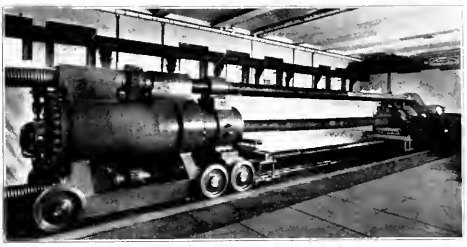
The Bureau is a great research laboratory, yet it is not isolated, but is constantly in touch with the producers and consumers all over the country.

There are about 70 sections in the Bureau's organization, each devoted to a special line of work. On first thought it might appear that each of these would be somewhat cut off from the others. This is not the case. Frequently a major research will require the cooperative efforts of many sections, and even in the ordinary testing of materials, nearly always at least two sections, say in physics and chemistry, are involved. Regular reports on the progress of work are required which are made available to all divisions of the Bureau. In addition, weekly meetings are held during the winter, and are attended by all members of the staff. The progress of work is described and future plans discussed.

The functions of the Bureau are the development, construction, custody, and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

Standards are divided into five classes, as follows:

(1) Standards of Measurement (measurements of length, mass, and time)
(2) Standard Constants (mechanical equivalents of heat and electricity, constant of gravitation, etc.)
(3) Standards of Quality (specifications for materials)
(4) Standards of Performance (operative efficiency of machines and devices)
(5) Standards of Practice (safety codes for technical regulation of construction and operation of equipment)



High-precision Emery horizontal testing machine. Capacity: 1,150,000 pounds in tension; 2,300,000 pounds in compression.

The organization of the Bureau is based not upon the classes of standards, but upon the kind of work.

There are two major groups in the Bureau's organization, the first dealing with research and testing, and the second with commercial standards. Each is in charge of an assistant director.

The work of the commercial standards group covers the important fields of simplification and dimensional standardization, limitation of variety, use of specifications by private purchasers, solution of economic problems of building and housing, and related subjects. The activities are conducted in close cooperation with producers, distributors and consumers; in fact the effectiveness of the work is dependent very largely upon the attitude of these groups, rather than upon the efforts of the Bureau. The latter's functions are rather to get these groups together and to point out ways in which the desired ends of better and cheaper products can be brought about.

That the work is effective is proved by the fact that actual field surveys covering industries which have adopted the Bureau's simplified practice recommendations show nearly 87 per cent of the production to be in accordance with these recommendations. Various leaders in industry estimate that simplified practice is saving $300,000,000 per year, and investigations showed that the benefits are

shared in large measure by the distributors and users.

The commercial standards group is conducting an active campaign to bring the advantages of buying by specification to the attention of private purchasers. By its development of the "certification plan" with lists of willing-to-certify manufacturers and its classified list of testing laboratories the Bureau has made it possible for the private purchaser to buy goods in small quantities on practically the same basis as the large purchases of the National Government. Close contact is maintained with the Federal Specifications Board, of which the Director is Ex-officio Chairman, and many of the specifications have been adopted by State and other purchasing agencies, outside the National Government.

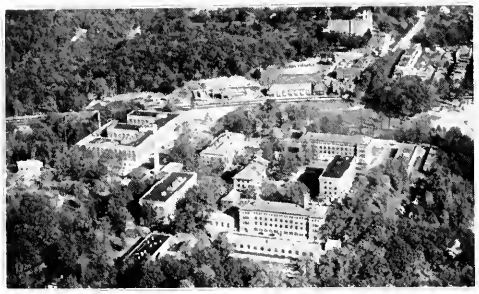
In the field of building and housing the Bureau has issued the important recommendations covering the construction of dwellings, plumbing installations, city planning and zoning, and home financing. Seasonal construction has been reduced and building codes brought into closer agreement. As in the case of the other work of the commercial standards group, the Bureau's activities in the housing field can only be effective when supported by the builders, owners, and municipal authorities. The work has met with hearty support in every section of the country, and the Bureau's recommendations have been incorporated in numerous State and municipal codes and regulations.

The research and testing group consists of nine major divisions which are subdivided into sections, the section being the working unit which deals with some particular class of problems, such as time measurements, electrical measuring instruments, textiles, etc. It would be impossible to describe the activities of every section in the limited space of a magazine article, but items have been selected which may be taken as typical of the Bureau's work as a whole.

The Weights and Measures Division is the basic division of the Bureau, a natural outgrowth of the work of the old office of weights and measures in the Treasury Department. This division has custody of the National standards of length and mass of the United States, upon which all our other standards depend.

In this connection, it is interesting to note that the Bureau has ruled precision scales for a manufacturer of high-grade tools direct from light waves with an accuracy so great that there was no measurable error in the finished scale. Precision gauge blocks, the master length standards of our automobile manufacturers, etc., are likewise tested by optical methods with wonderful accuracy.

You may ask quite naturally how the Bureau assists in securing exact standards of measurement in commercial transactions, when the enforcement of weights and measures laws is entirely a State or municipal function. One way in which this is accomplished is through conferences of weights and measures officials from all sections of the country. Each spring such a conference is held at the Bureau. Delegates from many of the States are present, and all sorts of weights and measures problems are discussed. Thus, without any regulatory power, the Bureau is helping to secure uniformity in these matters in all parts of the United States.



Airplane view of the Bureau of Standards. Each building is designed for some particular class of work.

The Bureau owns four sets of equipment for testing railroad master scales and commercial track scales. The charges for all the revenue freight moved in this country, a matter of over four billion dollars per year, depend on the readings of these scales. In 1914, when the work was started only 38.2 per cent of the scales tested were within the limits of error set by the Bureau as an acceptable standard of performance. During the fiscal year 1928, 18 master scales and 703 commercial track scales were tested, and of the last named, 70.0 per cent were within the tolerance. The importance of such an improvement is obvious.

The necessity of a laboratory fitted to deal with the basic standards in electricity was one of the strongest arguments for the establishment of the Bureau. The field covered is very extensive, including the establishment and maintenance of the fundamental electrical units, such as the volt, ampere and ohm; the testing of electrical measuring instruments, lamps, batteries, etc., the investigation of important problems in the electrical field; and the preparation of safety codes covering the electrical and other industries. At present much attention is being given to a redetermination of the basic electrical units, the Bureau having been assigned numerous problems along these lines by the International Bureau of Weights and Measures, which has mapped out the work for the various national laboratories.

One of the sections of this division deals wholly with radio communication, and many important improvements in this rapidly expanding field have been developed at the Bureau. The radio direction finder, now largely used in navigation, the radio beacon, the quartz oscillator, and many other developments were invented or perfected by Bureau of Standards employees. Just now, a great deal of attention is being given to the elimination of interference in broadcast reception, the control of frequency of transmitting stations and the development of radio beacons for aerial navigation.

The problem of automobile headlighting has been the subject of extensive investigations. In cooperation with numerous States and cities a considerable improvement has been brought about in this matter.

The work of the automotive power plants section of the Heat and Power Division is of special interest to engineers. This section conducts investigations of the performance of all sorts of internal-combustion engines, including those used in aircraft and automobiles. Automobile engines are not only tested in this laboratory but complete records of car performance on the road are secured by special apparatus. Through such work the efficiency of automobile engines is being increased with a consequent increase in miles per barrel of crude oil.

In the altitude laboratory aircraft engines are tested under conditions encountered during an actual flight. The low air pressure and temperature existing at high altitudes can be duplicated in a chamber specially designed for this work. Aircraft engine testing was started when we first entered the war, and for some time the Bureau's altitude chamber was the only one of this kind in the world.

The Bureau is by law the testing laboratory of the Aeronautics Branch of the Department of Commerce, and the type testing of commercial aircraft

engines is now one of the major activities of the automotive section.

It may seem a far cry from engines to thermometers, but the establishment of standards for each involves

The largest disk of optical glass ever made in the United States. 70½ inches diameter, 10½ inches thick, weight, 3900 pounds.

heat and temperature measurements. The Bureau tests many thousands of thermometers each year, as well as pyrometers and other heat and temperature measuring instruments. One section of this division is concerned with the fire resistance of structural materials. Actual building materials, including full-sized walls and partitions are tested in special furnaces, and the intensity and duration of fires are studied in actual buildings, and in special test houses. These are completely furnished with discarded material to simulate any desired occupancy, and are then set on fire. The temperatures attained are indicated by means of thermocouples and the time the fire burns is noted. Through this work better building construction is being brought about with a reduction of our tremendous fire loss which amounted to $500,000,000 last year.

The work of the Optics Division includes such important subjects as spectroscopy, the investigation of sugar production and testing methods, the design and improvement of optical instruments, the use of light interferences in precise measurement, and the protection of the eyes from injurious radiations as well as studies of the ultra-violet transmission of glass and fabrics. The work leading to the establishment of the dextrose industry and the research now under way on levulose are important phases of the work of this division.

The spectroscope reveals to us the composition of the sun and stars, showing us that vast as is the visible universe it is made up almost entirely of elements with which we are familiar here on earth. In addition to telling us the constitution of a star hundreds of light years away, the spectroscope is the most accurate known means for analyzing metals and will reveal traces of substance which cannot be found at all by chemical analysis.

By means of an extremely sensitive thermocouple the surface temperatures of the planets have been measured, and results secured which may eventually lead to a determination of whether life exists on other members of the solar system.

The work of the Chemistry Division covers a great variety of subjects, many of the investigations being carried out in cooperation with other divisions of the Bureau. A great deal of the testing in connection with the preparation of Government specifications is performed by this division. Standards for paint, varnish, rubber, cement, reagents, etc., have been established. The electrochemistry section has done some interesting and valuable work, including the development of a process for chromium plating. This is being used by automobile manufacturers, by makers of precision gauges, and for coating the steel dies used by the Mint, and the steel electroplates used for our currency printing. Even the case-hardened steel plates wear out very rapidly, and by covering the surface with chromium, the hardest metal known, their life is greatly increased. Another section deals with gas appliances, and has made a study of the proper utilization of gas in domestic appliances, the heating value of gas of different compositions, etc. Assistance has been given various municipalities in determining the responsibility for some cases of carbon monoxide poisoning.

The work of the Mechanics and Sound Division includes the testing of mechanical appliances, such as elevator interlocks, fire extinguishers and water-current meters, the investigation of the sound proofness of building materials, the development and testing of aeronautic instruments for the air service, the study of the aerodynamic properties of structures, and the determination of the strength of fabricated metals, ropes, and cables.

Studies made in the sound laboratory have yielded valuable data on ways for rendering walls and floors more resistant to the passage of sound, and several publications have been issued giving practical information on the sound proofing of buildings. The performance of all sorts of devices and structures which must function in a wind stream are studied in three wind tunnels. One of these is 36 inches in diameter, and in it a wind speed of 180 miles per hour can be maintained. The second tunnel is octagonal in form with a cross section 54 inches between the sides. The third tunnel is 10 feet in diameter. The maximum wind speed possible in these last two tunnels is about 80 miles per hour. Many models of aircraft, aerial bombs, tall buildings, and chimneys have been studied by means of this equipment.

Current meters are used for measuring the flow of water in rivers and open channels. At the Bureau they are tested by towing them from a small electric car moving on a track over a tank 400 feet long. Thus, the meter moves through the water instead of the water flowing past the meter, but both produce the same result.

The big testing machines of the engineering mechanics section are always of interest. The largest of these is a vertical machine with a capacity of 10 million pounds in compression. This machine was used to test the special columns made for the new Delaware River bridge between Philadelphia and Camden. The machine is operated hydraulically, oil under a pressure of about 3,000 pounds per square inch being supplied to a cylinder 52 inches in diameter located below the floor. The Bureau's largest horizontal Emery testing machine does not have so great a capacity as the vertical machine just mentioned but is much more sensitive and accurate, in fact, it is really a precision instrument. This machine is capable

Ten-foot wind tunnel with a maximum wind velocity of 75 miles per hour.

of loading a specimen to 1,150,000 pounds in tension and to 2,300,000 pounds in compression. Variations of load only one or two pounds can be detected.

The Organic and Fibrous Materials Division deals with rubber, textiles, paper, and leather. In establishing standards of quality and performance for materials of this kind, it is often necessary to study the actual manufac-

(*Continued on page 68*)

Color and the Motion Picture

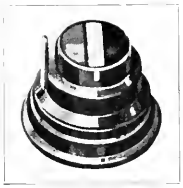
By M. B. Golber, '29

Student in the Department of Mechanical Engineering

Dr. C. E. K. Mees, director of the Eastman Kodak Research Laboratories.

The great popularity of motion pictures has led to many attempts to further the illusion by the reproduction of the natural color of the objects photographed. The first attempt in this way was, of course, the staining of the entire film. In this way effects can be obtained in which browns or greens or reds predominate, but these unnatural and unreal colors soon tire the eye, and so are in use at present only on the so-called short subjects and in those parts of the larger productions where the color will lend an added emphasis to subjects shown. An example of this is the common practice of staining fire scenes to a deep red color.

Another obvious method of producing color on the screen is the hand coloring of the individual pictures on the film itself. When one considers that many films contain five or more reels, each reel containing at least 16,000 pictures, it can be seen that the time and expense required for the coloring of a typical film are very great. In spite of these difficulties, hand-colored films are still produced. The colors are generally limited to the less brilliant colors such as pink, bluish-green, yellow and brown, but the effect is nevertheless quite pleasing and agreeable. Such pictures are frequently painted through the use of a pantograph arrangement; the picture is thrown upon a screen and the artist follows the enlargement with the tracer of the pantograph. The other end of the pantograph holds the brush and follows in lesser proportion the movements made by the artist in following the outlines of the image thrown upon the screen. The time and care required for the production of hand-colored films is almost prohibitive in expense except in special cases, and the process is not of much commercial value.



The Kodacolor lens filter.

Other processes have been developed, however, which depend upon the same phenomenon as the ordinary black and white projection. This is the optical phenomenon known as persistence of vision. An image formed upon the retina is retained for an appreciable time, and if succeeding images are formed at the rate of sixteen or more per second, a composite will result which will appear as a motion picture.

This phenomena is equally applicable in color. If red is thrown upon the retina, and is followed by green before the image of the red has had time to fade from the retina, the brain will record the color as yellow without being conscious of the fact that the components of the color image received are red and green. Similarly, should blue-violet light be added to the other two the brain will receive the impression of white light. This process of color production is known as an additive one, for it starts with black (the absence of all light) and adds light to light to produce the desired shade.

This method has a number of disadvantages. A great disadvantage of this process, and in fact, of any process which utilizes pictures of different phases of a moving object for different colors is that it is impossible to obtain a perfect composite image. It is a fact that sixteen or more pictures per second result in a satisfactory illusion of motion if the pictures are all in the same color. But if the successive pictures are not all in the same color, the composite result is not a satisfactory one. The image upon the screen appears to be "fringed" with colors, particularly upon the highlights. The cause of this fringing can readily be seen if one imagines the use of the process with successive pictures of a very simple object such as a ball falling past the camera. Obviously, we have a red picture of the ball in one position, a green picture of the ball in another position, and a blue picture of the ball in still a third position. It is impossible to register these pictures one upon the other, and in projection the ball will appear first with a red fringe at the top and a green fringe at the bottom, then with a green fringe at the top and a blue fringe at the bottom, and so on. These fringes would also be present with black and white photography, but due to the single color used they would not be noticeable, and the resulting image upon the screen is satisfactory. This is due to the fact that the eye seems to be more sensitive to color combinations than to motion.

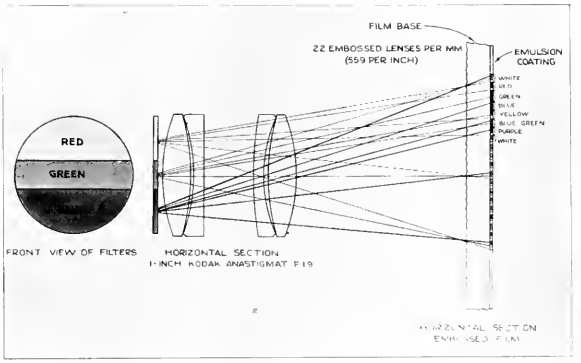
Another defect in this type of projection is an irritation technically known as color bombardment. This is a physical effect produced by the rapid alternation of colors necessary in the process. This irritation in some people takes the form of intense discomfort and a severe headache. It is probably due to the unequal color sensitivity of the eye, for while the alternation of red and green produces the sensation of yellow, yet there is a pulsation or throbbing which while it is not a flicker is yet closely allied to it.

These disadvantages have led to attempts to take and project the individual pictures simultaneously, so that each image appears upon the screen complete in itself as regards color. While this method obviates the eyestrain caused by the color bombardment, and also the fringing accompanying the first process, it introduces other difficulties. If more than one lens is used, that is, if two or three lenses are placed horizontally or vertically in line, then the element of stereoscopic parallax is introduced; for each lens receives a slightly different picture of the subject being photographed. Also such an arrangement of lenses requires either special film of extra width, or necessitates the advance of the film at from two to three times the normal rate of travel used in black and white photography. In any arrangement of this kind, special devices become necessary which are not only costly but require the almost constant services of an operator.

These difficulties led, in 1907, to a two-color process known as Kinemacolor, which with certain changes is still in use today. In this process alternating pictures are taken and projected through a rotating shutter with red and green sectors. This process is handicapped by color bombardment, but owing to its simplicity is much in use, as the only extra equipment necessary is the rotating color shutter with the fitting of a few gears to speed the travel of the film. Fringing is still present, but owing to the use of only two colors is not very prominent.

This system is based upon the fact that in tri-color projection the blue-violet light adds little color as such, although it brightens the other colors and forms white. But white is relative, and in two-color projection we accept as white a color that is actually a shade of yellow. The combination of the colors is also aided by the fact that the green filter used passes a large amount of blue light.

The Kinemacolor camera, projector, and films are similar to those used in ordinary black and white photography, but run at twice the speed; that is, two feet or thirty-two exposures per second. The shutter is a rotary one and is so geared to the handle by which the film is moved that the light reaches the screen only while the film is at rest. The principal difference between the Kinemacolor camera and the ordinary type is that the former has a rotating color-filter placed between the object and the sensitive film. This filter consists of an aluminum skeleton wheel filled in one segment with red-dyed gelatine and in another segment with green-dyed gelatine, and so geared to the handle that the exposures are made alternately through the red and the green gelatine filters. The film used differs from the ordinary one only in that it is equally sensitive to red and green light. After being exposed in the Kinemacolor camera, it is developed and positives printed from it in the usual manner. The individual pictures are standard, except that they have been exposed alternately through the red and the green sectors of the filter. The film must obviously be of twice the length of the black and white film for the same amount of the subject, and must run at twice the speed.



This diagram shows how the rays from the three filter colors are laid on the emulsion by the embossed lenses as one, two, or three impressions according to the color that is reflected to that point.

A number of devices and arrangements of the pictures on the film have been designed with the object of reducing the length of the film and its rate of travel. Among these may be mentioned the use of two rows of pictures upon a standard size film, each row corresponding to one of the two colors used. The center of a picture in one row is placed opposite the division line between two pictures in the other row, and the apparatus is designed to move the film laterally as well as vertically, so that it takes a zig-zag course through the camera. These devices, although lessening the length and speed of travel of the film, introduce other features that are less desirable, such as complications in the apparatus, and so the scheme first described is in most common use.

The Gaumont method of producing colored motion pictures, although one of the oldest, is considered by some to be superior to the Kinemacolor, even though it requires such special apparatus as to render it of little commercial value. The process is in short as follows: Three pictures are taken with an exposure of one-thirtieth second through three lenses simultaneously, each being furnished with its respective color filter. After each exposure the film is moved on over the space occupied by the three pictures. Projection is accomplished by three lenses each carrying its own color filter, which is slightly different from the one used in taking the negative, and registration is effected by moving the top and bottom lenses in three directions by a very ingenious mechanism.

It is only within the last few years that the motion picture has entered into the realm of the amateur photographer, but it is only natural that with the great popularity these "home movies" have had that the efforts of the manufacturers should be turned toward the production of a simple method of color photography for home motion pictures. The Eastman Kodak Company announced their new process of Kodacolor on July 30, 1928.

In Kodacolor the part of the amateur photographer has been made as simple as possible. It is merely necessary for him to attach a special color filter in front of the lens and to thread a special Kodacolor film in the place of the ordinary film. Otherwise, he does nothing more than he is accustomed to doing.

The secret lies in the film he uses. Into it are molded hundreds of tiny lenses. These lenses are cylindrical lenses embossed directly upon the film base material during the course of manufacture and extend lengthwise of the film. These lenses on the film are about seven times narrower than the tiny dots used in making up the illustrations in a newspaper, there being 559 of them to the inch. As such they are visible only by the use of a microscope. The lenses completely cover the surface of the side of the film opposite to the light sensitive emulsion. In contrast with the ordinary arrangement of the film in the camera, the side with the emulsion is faced away from the lens, while the side

(*Continued on page 74*)

AUTOMOBILE TESTING

By James C. Zeder
Chief Engineer, Highland Park Division
Chrysler Corporation

DUE to the fact that the automobile buying public constantly demands something new, the designer is faced with the difficulty of working with problems that represent a departure from conventional design. Consequently, in the usual case, no proven formulas or reliable sources of information are available to supplement his own experience and judgment. Common practice of only a few years ago was to put a new product on the market, untried, letting the owners develop any weaknesses that happened to be present. Present day conditions of large production and frequent changes make this method impracticable.

Designing and testing now are closely related, so that no design is considered satisfactory until it has been found to perform successfully under all conditions of operation that might be encountered in actual service.

At the first glance, the problem appears to be merely a question of checking design by its performance on experimental cars. This procedure alone would be insufficient for several reasons. In the first place, the cost of maintaining a fleet of cars to test every experimental part submitted would be enormous. Secondly, accurate comparisons of various constructions are difficult to obtain on the road, as successive car tests cannot be run under exactly the same conditions of service. Also, a part which has given satisfactory service on the road does not necessarily have a factor of safety to provide for possible deficiencies in material or workmanship. Finally, there is something of an element of danger involved in testing radical designs in this manner without preliminary testing.

From the above, it is apparent that a complete engineering department must have research and testing laboratories to fill in the gap between the drafting room and road test departments.

The Chrysler Engineering Division has Mechanical, Electrical, Power Plant and Research Laboratories, where all chassis parts are tested before being installed on cars. In addition to the above, materials of these experimental parts are tested in the Physical, Chemical and Metallurgical Laboratories.

The Mechanical Laboratory is maintained for the purpose of determining and analysing the operating characteristics of various mechanical units, so as to assure satisfactory performance in actual service. Many ingenious units of testing apparatus have been designed and built to duplicate car conditions and produce accelerated results.

In testing brake lining, it has been found that several weeks are required after installing on a car for the lining to become worn-in, so that an accurate test may be made of the frictional value of the lining. Because of the large number of samples submitted for test and the limited time available, it would be practically impossible to give every sample a thorough road test. To relieve this situation a brake lining machine was developed to obtain the required results in a very short period of time.

This machine is in reality a form of dynamometer with the exception that the pressure of applying the brake is a known quantity as well as the torque developed by the brake. It is used for studying the variation in friction as wear progresses, effect of temperature and cutting action on the drum.

The drum is internally cooled by circulating water which enters and leaves the drum through drilled passages in the shaft upon which the drum is mounted. The braking mechanism, including sample and shoe, are assembled in a statically balanced housing, pivoted on large ball bearings. Due to the friction of the sample, the housing tends to rotate with the drum but is resisted by the liquid pressure built up by a piston in a cylinder. The pressure in this cylinder is of course proportional to the coefficient of friction and is consequently a measure of braking ability. An automatic recording pressure gauge connected to the cylinder gives complete record as wear progresses.

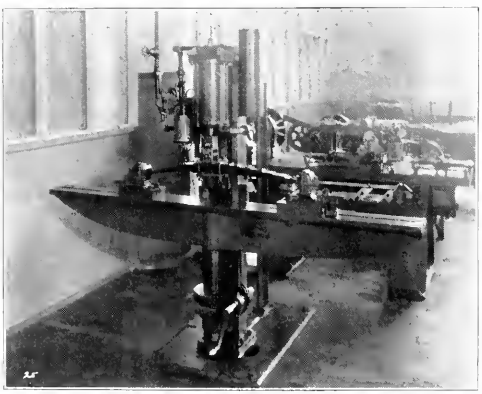
Application of the brake is accomplished by a compressed air cylinder which is adjusted to give the desired braking pressure by a throttle valve and pressure gauge connected in the line.

In making comparisons of rear axle carrier parts and assemblies, it is necessary to conduct successive tests under exactly the same conditions to obtain accurate results. Since driving conditions cannot be exactly duplicated on successive tests, a machine was designed and built whereby operating conditions could be maintained constantly for any desired period.

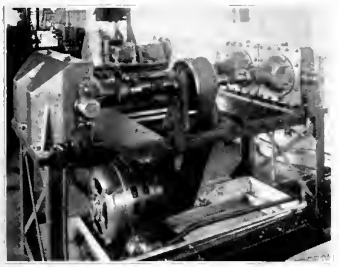
On this test, four carriers are tested simultaneously, making it possible to obtain comparisons of different constructions on one test as well as being comparative with results of former or future results.

The axle carriers to be tested are bolted to the face plates of water jacketed housings and connected in pairs on each end by spline shafts through the differential gears. The opposite ends are then connected by shafts bolted to the pinion flanges. Universal joints compensate for any misalignment.

The unusual feature of this machine is the method of applying a load on the axles. To obtain results in a comparatively short period of time, it



The spring test machine which registers each time the spring is depressed; for determining the life of springs.



Another interesting machine which was developed by Chrysler engineers for testing rear axles.

is necessary to apply an overload torque. If this torque was transmitted in the usual manner, an enormous size motor would be required, besides some means of dissipating a large amount of energy. To make the machine as simple as possible, it was designed for operation under a condition of internal torque, so that the only requirement of the motor would be to overcome the friction of the machine at the desired speed. The system of axle carriers, spline shafts and universal joint shafts forms a single unit. This system is assembled with an initial twist or torque which is locked in the unit until failure occurs or until relieved in disassembly. For applying the torque, two companion flanges are provided in connection with one of the universal joint shafts. These are normally bolted together, but in introducing the torque the bolts are loosened, and the two flanges twisted in respect to each other, to obtain the required torque.

Experimental chassis springs and shock insulators are tested for endurance on a machine which automatically oscillates the center of the spring through an adjustable stroke until failure occurs. The spring is compressed by the piston rod of an air cylinder, which is controlled by a two-way rotary valve. Operation of the valve is accomplished by the plunger of a solenoid, which is energized and de-energized by the making and breaking of the electrical circuit by a contact that moves with the spring. One position of the valve forms a direct connection between the air line and the air cylinder while the other allows the air to escape to the exhaust.

The stroke may be adjusted by raising or lowering the cross beam. The usual practice is to set the stroke at a distance somewhat more than may be attained on a car.

Shock absorber performance is a very difficult quality to determine accurately on the road, since different persons may not give exactly the same criticism of the ride obtained by the use of a particularly installation.

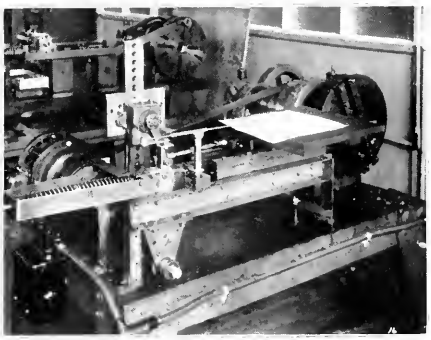
To get away from personal judgment and at the same time provide a means of making accurate records, the idea was advanced of testing shock absorbers on a machine which would automatically plot resistance against stroke.

The shock absorber to be tested is bolted to a pivoted member with the arm or strap attached to the cross lead of the machine. Movement of the pivoted member is restrained by a calibrated coil spring which deflects, giving a movement to a pencil connected through linkages to give straight line motion. Printed forms are made with ordinates giving the resistance pressure in pounds and abscissa the stroke in inches. In making a diagram, a chart is fastened on the table, the machine started and the diagram drawn.

The machine has been found very valuable for quickly showing the characteristics of a shock absorber as well as pointing out the effect of setting, strokes, speed and temperature. It is also used in checking up on performance before and after installations on experimental cars or on endurance tests.

The endurance test is in conjunction with the shock absorber performance test previously described, and gives accelerated results which are directly comparative. A motor block was used in making this set-up, as it provided a simple means of obtaining the reciprocating motion necessary for a shock absorber test.

The usual procedure is to set up the



An ingenious machine which records the performance of shock absorbers.

machine with four shock absorbers to be compared. After a test period consisting of a predetermined number of cycles of operation, performance charts are taken and compared with charts taken before the endurance test for observing any change in action that occurs after extended service. The set-up is also useful in determining temperature rise and leakage of hydraulic devices when subjected to severe action.

Increased engine speeds of the present day have made necessary a thorough study of valve springs and their actuating mechanism.

As a result of years of experience, it has been found that satisfactory spring design cannot be attained by the simple application of well known formulas. It has been proven that vibration may set up stresses that are 100 per cent in excess of that calculated by the use on conventional formulas.

Several pieces of equipment are used in the study of valve spring vibration. The Stroboscope and the Vibroscope enable the observer to watch the movement of the spring while actually operating a high speed. The value of this apparatus is limited, as there is no means of recording or measuring the vibrations. A vibration indicator was consequently worked out for this purpose that produces a permanent record at any speed. The frequency of the spring in vibrations per second, the amplitude in inches and the speed in r.p.m. are recorded on a strip of paper and may be measured by a special scale. A set-up to take photographic pictures of vibrations has also been developed. This apparatus makes it possible to record a complete picture of the vibration of a valve spring throughout the entire speed range.

In order to select the most suitable material from the numerous samples submitted, specimens are first subjected to the twist test. One end of a piece of wire 11 inches long must twist fifteen times about its axis in one direction and eight times in the opposite direction without showing any seams or intermittent openings on its surface. If successful on this test, a sample of the same material is then vibrated continuously through a stress range from 0 to 100,000 lbs. per square inch at a rate of 4,000 times per minute. The stress load is determined by the angular displacement, the wire size and the length of the sample. This machine makes it possible to test a wire sample in a very short time and eliminates other variables which are usually encountered on fatigue tests of the finished spring.

The general functions of the Power Plant Division is the measurement of

(*Continued on page 70*)

Stage of the Audubon Theater, New York City. The lighting of the auditorium itself presents numerous problems.

STAGE LIGHTING

By F. H. Juergensen, '29

Student in the Department of Electrical Engineering

(*Cuts courtesy of Curtis Lighting, Inc.*)

IT IS a known fact that in order to see a body there must be some light reflected from that body, so stage lighting is as old as the theater itself.

The first theater was in a circular space between the hills, with seats arranged up the slopes on three sides, the stage being on the fourth side. This Greek theater of the sixth century B. C. was followed by the Roman theater, which, by means of arches, etc., was built up from the level ground.

The next that is heard of theaters is about 1100 A. D., when "Miracle Plays" were staged in churches and nearby places. Sometimes a series of stages were placed alongside of each other or above each other for different scenes, so that time would not be lost. Portable stages were also used for supplying the isolated portions of the country with drama.

All performances up to the fifteenth century were given by daylight and the first record of artificial lighting is of the candles burning before the shrine. These were supposed to give local color to the devils, showing a realization of the value of lighting for its psychological influence, entirely aside from its use for illumination.

It was not, however, until toward the close of the sixteenth century that completely enclosed theaters were erected and performances given in the evenings. The stage and interior were illuminated by cressets, lanterns and candles—the same smoking, inefficient means for producing light that had been used by the Greeks, Romans and early Christians.

Footlights and borders were introduced by David Garrick in 1755. He placed a row of candles below and in front of the stage and masked them by metal screens. He also placed lamps along the wings, invisible from the audience. The sole purpose of these lights was the illumination of the players, showing that the artistic value of stage lighting had not yet been evolved. An amusing thing to note is that the lighting systems were all proclaimed at that time to give brilliant illumination.

Early American stages and theaters were illuminated by candles, which soon gave way to lamps with glass chimneys, burning kerosene as their fuel. Sometimes the chimneys would break and give up a dense cloud of black smoke, but this was better than having "snuffers" trimming candle wicks in the midst of a tense situation, and therefore, theater-goers were satisfied.

Despite the number of lamps used in a theatre, the light thrown on the actors was just enough to make them recognizable, and so it was with a great welcome that gas lighting came into use. At this early stage there were no central gas stations to manufacture and feed gas into the mains, so that if a theatre manager wanted gas lights he had to install and operate his own plant. The methods of manufacture were not of the best and even with its superior illumination qualities, gas lighting did not come into general use until the middle of the nineteenth century. The value of gas lighting was due to its being subject to regulation and control rather than its illumination; it was possible to darken the auditorium and brighten the stage during the performances. Many different effects could thus be produced. The gas was all regulated from one point in the building, but because of the crude

methods for lighting the gas, it was very seldom that they turned them completely out, and that was at the risk of fire to light them again.

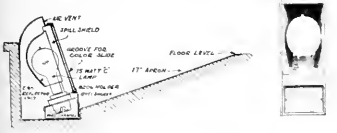
Another method of lighting was by lime-light, which consisted in heating a piece of calcium to a high temperature, whereupon it gave off a brilliant white light. By playing a burning mixture of oxygen and hydrogen upon the block of lime, a concentrated light was produced which was used as a spot to follow a character about the stage.

It was during the time of gas lighting that color lighting was introduced and people began to think about scenic illusions, which brought many radical changes. The start was made by drawing thin colored silk in front of the lights, although in this way only one dominating color was the extent of the coloring. Automatic operation was made possible by mounting a rotating cylinder around the lights, and having sections of this cylinder different colors.

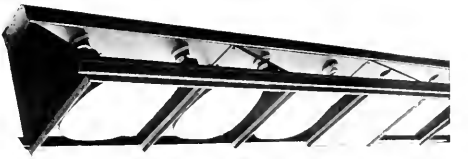
The main disadvantage of gas lighting was that the equipment took up as much room is the scenery itself; rubber tubes trailed everywhere. In an article dated August, 1861, are listed as disadvantages, dazzling the eyes of the actors and making it dangerous for dancers. It also tells that the lights made the upper boxes and galleries very warm, and that the smoke and reflectors obstructed the view.

It was at the Paris Opera that electric lighting made its debut in 1846, when the rising sun was represented by the reflection of an arc lamp on a white screen by means of a parabolic reflector. At this time the arc light was the only means of illumination by electricity and so the gas lamp, improved by means of a mantle, held the field.

It was about 1880 that Thomas A. Edison, an American, invented the incandescent lamp, which soon was to surpass all other methods of lighting. These lamps were first installed in the Paris Opera in 1880 and 1881. In order to excel the one great advantage of the gas lamps, that of control, it was necessary that the electric light system could be controlled from one point. As this was done even better than previously, electricity was in the theatres to stay. Mechanically operated screens produced the change in color the same as with gas lamps, and in September, 1882, a Congress of Theatre Managers assembled and issued a formal report favoring the lighting of halls and theatres by electricity. After the installation of electricity, many scenic effects were produced by ingenious managers.



A cross section of a modern foot light. A proscenium strip; these are mounted vertically along the sides of the stage.



A border strip, which directs light down on the actors.

The adjustment of the circuits was made entirely by resistance, the first resistance being a water barrel rheostat, consisting of two plates immersed in a barrel of salt solution, the resistance being varied by changing depth of immersion of one of the plates. These dimmers were not very satisfactory, as the same results were never produced twice, and oftentimes disagreeable odors were produced upon overload. The next dimmer used was made up of resistance coils, tapped and connected to switch-points, so that any desired resistance could be included in the circuit.

Since electricity has become established in the stage lighting field, many improvements have been made, and as it would be impossible to give a history of these facts, we will leave that subject and look into the modern stage and its lighting.

As to the importance of the art itself, David Belasco said, "There is very much more in stage lighting than mere color and intensity. Just as sounds of various purity, intensity and tone may be combined into a concordance that has expression and meaning, so light, varying in purity, intensity, color and distribution, can arouse the sense of beauty."

By means of a proper arrangement and adjustment of lights, involving merely a change in their color or location, scenes can be quickly changed from one to the other. This shows how immensely important these quick change facilities are to any theater manager or producer. It is possible to change the scenery from one of outdoors to a living room by merely making the proper changes in the lights, sometimes by the throwing of only one switch.

The theory behind these seemingly miraculous phenomena is very simple, and lies in the fact that a colored fabric will only reflect the colors present in its painting. For example, a red light shining on a tapestry will be reflected from only the red surfaces, the remainder of the tapestry appearing dark and colorless. In the same manner a white light will be reflected from any color, due to the fact that white light contains the entire spectrum. There are not many things to remember about the colors of the lights themselves, except the fact that red, blue and green can be mixed to make any color, pure white being sometimes used to pale the shade of the color produced. We all know the ridiculous effect produced by having light shine on a person's face from a level lower than himself, and this is one feature which must not be overlooked in controlling footlights and overhead lights.

Stage lighting devices may be divided up into two main groups, those for providing general illumination and those for providing localized lighting. In the first group we have the foot, strip, proscenium and border lights, while in the second group we have the bunch and spotlights and effect machines or sciopticons.

The footlights are located at the front of the stage and are directed up at the players, which intensifies the facial expressions and assists in holding the attention of the audience. This lighting tends to reverse natural shadows and has been carefully studied and in some cases artistic productions have been well lighted without the use of footlights. It is common practice to install footlights, however, and the actors must take into consideration whether or not strong footlights are used and adjust their makeup accordingly. Common footlights of a few years ago consisted of a white painted sheet metal trough with porcelain sockets placed close together. Not much consideration was given to the design of this equipment and in some cases the persons sitting in the balcony could see the lights. To prevent this, inverted sockets were used and the lamps burned upside down, but either way, the colored lamps were just mingled haphazardly with the plain, and the purity of color was spoiled by passing through adjacent bulbs. This fault was somewhat remedied by using two rows of bulbs, white ones in the front and colored ones behind. The most modern type

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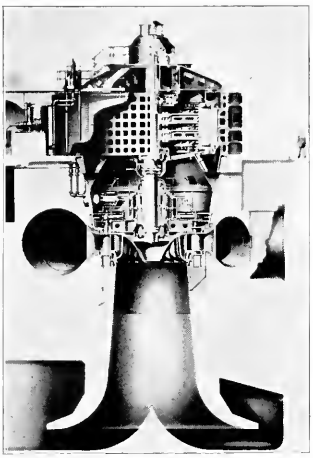
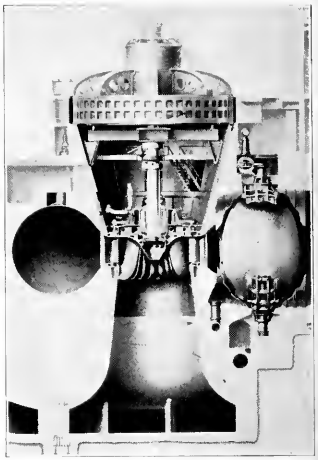


The world's most powerful hydroelectric unit —a section of a typical unit of the Niagara installation.

Developments in Hydraulic Turbines

By R. H. Earle, '17

Assistant Engineer,
Hydraulic Turbine Department,
Allis-Chalmers Mfg. Company



A section of a typical Conowingo unit. These machines develop 54,000 horsepower at 89 feet head.

Part II

In Part I of this article the relative importance of water and steam power was explained, and there were shown some of the engineering features of hydraulic turbines, particularly high head turbines or impulse wheels.

However, at lower heads it becomes advisable to change from the impulse to the Francis turbine. This transition occurs at heads between 700 and 1,000 feet.

A reduction in the head means a larger slower speed stream of water; the larger stream requires larger buckets and the slower stream means a smaller diameter disc in order to produce the desired speed. Hence, as the size of the bucket increases and the size of the disc decreases there is soon not enough room for the buckets; this situation usually occurs at heads from 700 to 1,000 feet. At these heads the use of the Francis runner begins in the spiral case turbine. In such cases the water is led to the machine in a pipe line which is then wrapped around the turbine in a sort of snail shell. The water is thus distributed around the entire circumference of the runner. The flow of water is regulated by the wicket gates which are a good deal like window shutters. These gates are opened and closed by the governor. The water flows into the runner radially and out at the bottom.

The most powerful Francis turbines built so far are the 70,000-horsepower machines for the Niagara Falls Power Company which operate under 213 feet head. The spiral casing for one of these machines at the time it was built was the largest ever constructed, but it has since been exceeded in size by the casings of the Conowingo turbines just put into service. These latter have water inlets 27 feet in diameter and were so large they could not be completely erected in the shops.

These two installations illustrate most of the modern design features of large Francis turbines, some of the main points being mentioned in the following:

All hydraulic turbines except impulse wheels have so-called "draft tubes," the one on the Niagara machine being the "Hydraucone" type. The draft tube is just below the runner and is a conical chamber flaring to a bell-shape at the bottom. The water after passing through the runner immediately enters this flaring chamber. Because of the increasing area of the

A large Francis runner. This runner develops 70,000 horsepower under 213 feet head at Niagara Falls.

passage the water is decelerated and exerts a suction on the bottom of the runner. This suction contributes additional head acting on the runner and increases the power delivered.

The draft tubes on the Conowingo machines are modified hydraucones.

Practically all large Francis turbines are now built with vertical shafts. The weight of the revolving parts is hung from a thrust bearing at the top of the generator and supported by the bridge. Guide bearings are then located above and usually below the generator rotor and another just above the turbine runner. The weight of the revolving parts on the Niagara machines is 700,000 pounds or as much as three good sized locomotives. Until Kingsbury produced his thrust bearing about twenty years ago it was necessary to make the large machines with horizontal shafts so that the weight could be carried in the guide bearings.

The main shafts on the Niagara and Conowingo machines are 35 inches in diameter and required the largest steel ingots now obtainable. The Niagara turbine shaft alone weighs about 80,000 lbs. and the generator shaft about the same.

As is usually the case the turbine gates are opened and closed by oil pressure acting on a piston controlled by the governor. The flyball element of the governor is shown just below the flange coupling between the turbine and generator shaft on the Niagara unit and just above the coupling on the Conowingo machines.

These turbines show the most modern design in steel plate spiral case machines. When the head on a large turbine is below 70 feet, however, the quantity of water is usually so large that it is not economical to conduct the water to the turbine through a pipe line. Instead the power house is

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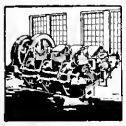


ENGINEERING NEWS

The Chicago Tunnel System

Below the sewers, below the mazes of pipes, wires, cables, and conduits, below the level of any subway that may be built, and silent and unseen, a freight tunnel system serves Chicago. The tunnels are forty feet under the surface, are reached only by elevators, and end against blank walls of concrete. Apparently they are known to few beyond the ranks of those whom they serve.

A network of these tunnels, connecting with all freight terminals and with many large buildings, covers downtown Chicago. The Chicago River is crossed at a dozen or more points. Over the sixty-two miles of twenty-four inch gauge track are hauled coal, ashes, excavated material, and freight of all kinds, to the extent of three thousand cars or more daily. The cars themselves are of three types. For handling freight a car four feet wide, twelve feet long, and of six tons capacity is used; ash and clay handling cars are of three and a half cubic yards capacity; and the coal cars are of four tons capacity. One hundred fifty electric locomotives (250 v. d-c.) and thirty-three hundred cars comprise the rolling stock.

The bores are made through a stratum of blue clay and are roughly six feet wide and seven and one-half feet high. Each tunnel has but a single track and trolley. A facing of concrete one foot in thickness and an extensive pumping system keep the tunnels dry. Waterproof and fireproof doors are provided to isolate connections with buildings and commercial terminals in case of fire or water from above. Pure air at a year round temperature of fifty-five degrees F. is provided by the ventilation system. Illumination is provided at all intersections and elsewhere when other than the train lights are needed. Glass reflectors at all intersections give warning of an approaching train. Despite the unfavorable conditions of operation, there has never been a major accident in the tunnels.

The chief business of the Chicago Tunnel Terminal Corporation is the handling of package freight, the tremendous volume of which traffic is created by trade and manufacturing in the Chicago district. From the various companies served, the merchandise is collected and delivered to warehouses or freight terminals as required. As one hundred thousand cars are loaded annually by this underground system, the surface is relieved of considerable heavy traffic. Incoming goods are either distributed to Chicago firms or transferred to other railroad terminals for reshipment.

Excavated material, cinders, and refuse are taken on scows, towed thirteen miles out into the lake, and dumped. Coal may be taken directly from coal yard to storage bins with little delay and with no obstruction of street or alley. The coal and ash requirements of one department store alone would require a hundred truck movements daily.

Finally, the value of the tunnel system to Chicago is not to be measured in terms of freight facilities alone. A public utility that can move three thousand cars or more every day from point to point within the most crowded area and add nothing to the traffic congestion of the streets in so doing is an urban asset of the greatest value.

Ice Engineering

The field of ice engineering is the most recent member in the field of engineering sciences. The tremendous loss in property, and the shutting down of power plants due to the formation of ice in rivers and lakes, and the ice jams present to the engineer a problem that will indeed try his mettle. In addition, there must be considered the loss of life entailed by ice jams and icebergs, and the great hindrance it is to navigation.

The method to be adopted for the solution of a particular problem depends upon the nature of the results desired, the relative economy of the method, and the judgment of the ice engineer. The aim of the engineer is not to melt large masses of ice; rather it is to assist the removal of the ice by using the natural forces of air, sun, and water to the best possible advantage. The problem of the ice engineer then becomes the selection of the method by which the natural disintegration of the ice can be obtained most readily, and most economically on one hand, or the prevention of this ice formation on the other hand.

The best method for handling ice situations, such as opening ship channels and keeping them open to navigation, is the use of ice-breaking ships There is no method as quick nor as economical as this. However, in those situations where ice breakers cannot work, the use of chemicals has reached the point of economic feasibility.

The most important and effective of these chemicals is thermit. Thermit is not an explosive; it is perfectly safe to handle and requires a special means of starting when it is to do its work. Thermit is a mixture of iron oxide and aluminum. When the mixture is raised to a temperature sufficiently high for the reaction to begin, an exchange of oxygen takes place, the iron oxide being reduced and the aluminum oxidized. The liberation of metallic iron and the formation of the aluminum oxide is accompanied by an extremely rapid evolution of a great amount of heat. The result is that the white hot, molten iron not only causes great strains in the ice but also decomposes it into its constituent hydrogen and oxygen with explosive violence. It is, therefore, not the thermit reaction but the ice itself that causes the explosion, the heat of the thermit being the means for setting it off. The use of thermit has been quite extensive for destroying ice bergs, ice jams, and preventing flood conditions due to ice formations, and in each case it has proven successful.

Among the other chemicals which have been used are common salt (sodium chloride), calcium chloride, and calcium carbide. Each of these is very successful in the destruction of hard surface ice.

The most economical and the most efficient method for the prevention of ice formation would be that which would utilize the natural heat of the water. Work along this line has been successfully applied practically at present to only a small extent. In certain places in Canada small tugs have been used to prevent surface ice from forming.

—Abstracted from *Tech Engineering News*.

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering
ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XX **January, 1929** **No. 2**

It is better for a man to maintain himself in good health than to load himself with learning. Indeed, I would rank good health very high in the major satisfactions of life.

—Arnold Bennett.

PROGRESS. Despite attempts to dampen the enthusiasm of the staff on the monthly proposition, investigation of such is going on quietly. Because of the fact that most of our advertising is national in character, and takes about a year to change from a quarterly to a monthly basis, there would be a deficit next year if the monthly plan were adopted then. Actually it would be possible to draw on the surplus of the Athletic Association to which the ENGINEER has contributed from its nominal income seven hundred dollars in the last few years. It is unlikely, however, that we be allowed to draw on this.

It is interesting to note that while our subscription price is one dollar and a half, the Athletic Association has contributed to the ENGINEER on the average of a dollar and thirty cents per year per student. This year we estimate our cost at a dollar and ten cents per student. Of the dollar and a half collected by the Institute ostensibly for the ENGINEER, a considerable portion is used to partly defray the expenses of the various athletic teams. We have made no complaint in the past, but now that we are aiming at greater things, we feel that we should be allowed to increase our demands on the A.T.A.A. fund at least until our advertising can be increased to a point where a dollar and a half per student will again care for our expenses. We have estimated our first deficit to be something less than four hundred dollars; if the student body would be willing to pay fifty cents apiece this entire deficit would be wiped out.

It appears at this date that there is no written agreement between the ENGINEER and the A.T.A.A. about the financing of the ENGINEER. We can find no mention of the ENGINEER in the A.T.A.A. constitution or by-laws. We can find no mention of it anywhere among the musty records of the past years. While we have been publishing four times a year for the last twenty years, it appears that we have had no constitution. Accordingly, one has been drawn up, revised several times, and is expected to be adopted in time to go into effect with the next semester. This constitution provides for a managing board—the present acting board being a self-constituted one. We will soon have a perfectly legal organization. With the formal confirmation of the board, further expansion of the staff is expected, particularly in the business department.

The constitution provides for six student and three faculty members on the board, the faculty members to be elected by the student members along with new students. Three professors have already accepted membership on the present board—Professors Peebles, Hendricks, and Freeman. It is expected that the management of the magazine will be placed upon a more firm foundation as the managing board exercises more and more of its authority. It will be the supervising body of the ENGINEER.

It will be our purpose in the very near future to ascertain whether the student body will be willing to pay fifty cents more a year in order to receive just twice as much for their money as they now receive. We sincerely trust that they will back us in this matter.

AWARDS. Since the publication of our last issue there have been received by us three certificates of award from the headquarters of the Engineering College

Magazines Associated. Every year the magazines of the twenty-one colleges which are members of this association are judged by the executive council at the annual convention. The three awards given us in the 1927-8 competition, results of which were announced at the convention at Lincoln, Nebraska, Oct. 25-6, were a second place in the cover contest, and two honorable mentions, one in the best single editorial contest, and one in the best illustrations contest. Mr. W. V. Zenner, our last year's editor, and his staff are to be complimented on the excellence of their work, which won recognition in the contest with many of the largest engineering colleges in the country.

Through the many kindnesses of Mr. Frank Oster, custodian of the Institute, these three awards have been placed along with the three won the previous year in an enlarged frame, and now hang in the lobby of the main building.

OUR NEWSPAPER. During the latter part of last semester there was launched at the Institute a newspaper, "The Armour Tech News." There had been talk of a newspaper for Armour for many years, but definite plans never were laid before last year. Various objections were always raised, it being claimed that there was not enough news for such a paper in our "small" school; that since the larger part of the student body lived right here in Chicago they all knew everything that happened here, and other such objections.

We are inclined to criticize the attitude which raises such objections, not alone in regard to the newspaper, but for many other new undertakings. For many years there has been much hairpulling and other gentle expressions of anxiety caused by the fact that only three and three-quarters persons out of every ten graduated from the Institute have cared enough about their alma mater to even send in their correct addresses—the three-quarters person probably being the one who sent in his address to the Alumni office but forgot to enclose his check for his Alumni Association dues. Yet we wonder why attempts to bolster up school spirit—as by establishing a newspaper—have seemingly been discouraged. Certainly anything which makes the school mean a little more to the student in his undergraduate days will make him remember it later.

Launched first as a semi-monthly, and then changed to a weekly, the Armour Tech News has justified its existence. To our mind it is the greatest single agency for binding our student body together and to the school launched since the formation of the Athletic Association in 1922. It is doing weekly, and with ease, what it was claimed could not be done semi-monthly. Its columns are read by three-quarters of the student body, which fact speaks for itself. It has made itself a vital part of our campus life. It is our earnest hope that its staff for the next year will carry on in as commendable a fashion, and that it may have as enthusiastic and capable a leader.

We would suggest, however, that the "News" and the "Cycle," as well, adopt a form of management similar to that recently devised for the ENGINEER, which provides for a managing board, or board of directors, composed of several students and members of the faculty in place of the old two-man management. It would without doubt make more certain the presentation of unbiased columns, better supervise staff routine, and make possible a better continuity from semester to semester, and year to year.

THE NOBEL PRIZE has, since its inception in 1896, become world famous in the realm of science. Because of the fairness and impartiality shown by the judges the recipients of these awards are considered authorities in their field of endeavors.

Dr. Albert Nobel created five awards; the winners to be selected yearly by a permanent Committee of Awards. The first prize is for the most important discovery or invention in the domain of physics; the second prize for the most important discovery or invention in the domain of chemistry. The Royal Academy of Science in Stockholm, Sweden, makes the selection of winners in physics and chemistry.

The third award is made in physiology or medicine. The Caroline Medical-Chirurgical Institute is intrusted with selecting the most logical person for this award.

The fourth award is in literature and is for the best production in that field, of an idealistic tendency. The Royal Academy in Stockholm selects this winner.

The fifth award is made to the person who shall have most or best promoted the fraternity of nations, the abolishment or diminution of standing armies and the formation of peace congresses. The Norwegian Storthing (Parliament) determines the recipient.

To be eligible for the Nobel Prize the scientific subject must have been read at a public lecture previous to the awarding of the prize. The person presenting this scientific discussion cannot himself bring it to the attention of the committees, but some disinterested person may present it for approval.

The award has a monetary value of about $42,000, a gold medal and a certificate. Within six months after the announcement of awards the recipients of the first four prizes lecture on the winning subject at the Royal Academy of Science in Stockholm; the Peace Award winner lectures before the Norwegian Storthing (Parliament) at Oslo, Norway.

The American winners of the Nobel Prize are eight in number. In Physics, Thomas A. Edison, Nikola Tesla, Prof. Albert A. Michelson and Prof. Arthur Compton of Chicago University; in chemistry, Prof. William Richards of Harvard; in medicine, A. Carrel; and the Peace Award to Elihu Root, former Secretary of State, and Theodore Roosevelt, former president of the United States.

WHAT IS GOOD

"What is the real good?"
I asked in musing mood.

Order, said the law court;
Knowledge, said the school;
Truth, said the wise man;
Pleasure, said the fool;
Love, said the maiden;
Beauty, said the page;
Freedom, said the dreamer;
Home, said the sage;
Fame, said the soldier;
Equity, the seer;—

Spake my heart full sadly,
"The answer is not here."
Then within my bosom
Softly this I heard:
"Each heart holds the secret;
Kindness is the word."

—*John Boyle O'Reilly*

MR. ELMER A. SPERRY, president of the American Society of Mechanical Engineers, is one of the outstanding men in the engineering world at the present time. He was born at Cortland, New York, October 12, 1860, and educated in the State Normal School of his native town. For a single year Mr. Sperry was a student at Cornell University.

The inventive genius of Mr. Sperry became prominent early, for while not yet twenty years of age, he had perfected one of the first electric arc lamps in America. Before he was twenty-one, the Sperry Electric Company of Chicago was established for the manufacture of arc lamps, dynamos, motors, and other electric appliances. Since then he has been active in the field of electro-chemistry, making possible an important commercial process producing caustic soda and bleach. He has also designed many types of electric mining equipment, electric carriages, street railway cars, and mechanical appliances.

Several years ago Mr. Sperry became interested in the gyroscope and its possibilities as a true compass. His investigations along this line confirmed his ideas, and also the belief that the gyroscope could be used as a ship's stabilizer. After much research and experiment Mr. Sperry brought out his active type of gyroscopic ship's stabilizer. This device actually prevents the rolling of ocean-going vessels. The marine world will, no doubt, be greatly revolutionized when the Sperry Stabilizer is completely developed.

Mr. Sperry has probably originated and designed more equipment than any other living engineer, having over 400 patents to his credit. During his fifty years of professional work he has done much for the betterment of mankind.

Mr. Sperry is a charter member and founder of the American Institute of Electrical Engineers and the American Electrochemical Society, a member of the American Chemical Society, Society for Naval Architects and Marine Engineers, Society of Automotive Engineers, American Physics Society, New York Electrical Society, and American Society of Mechanical Engineers.

Dr. Frank C. Wagner

Frank Casper Wagner, D. S., D. Eng., president of Rose Polytechnic Institute, consulting engineer of national reputation, and a noted educator, was killed on November 22, 1928, when the automobile he was driving was struck by an interurban car as he was leaving the campus at Terre Haute.

Dr. Wagner was born in Ann Arbor on Oct. 5, 1864. In that city he received his early education and attended the University, which awarded him three degrees. He was made a member of Tau Beta Pi and also of Phi Beta Kappa. Shortly after graduation he returned to the University of Michigan as a member of the faculty. In 1896 he was called to Rose, where he became professor of Mechanical Engineering. The presidency of that Institute devolved upon him in 1923 and was very successfully fulfilled until death ended his career.

Consulting work, especially as expert witness in patent litigation, was the field of his greatest engineering success. He was employed by some of the most distinguished patent attorneys in the country. His passing marks a great loss to education and engineering, and his absence is keenly felt by a host of friends throughout the country. We extend out sympathies to a sister institution.

College Notes

Scholarship Statistics

At the time of publication of the November issue of the Armour Engineer all the figures concerning scholastic standings were not available. Because of this fact, a supplementary list is here presented, which, together with the statistics already published, will make a complete scholarship record of the fraternities, classes, and student body in general, for the second semester of the school year 1927-28.

	Percent.	Rank.
Rho Delta Rho	86.6	6
Theta Xi	86.5	7
Phi Pi Phi	85.4	8
Sigma Alpha Mu	85.3	9
Delta Tau Delta	83.9	10
Average of all students	86.7	..
Average of fraternities with houses	86.64	..
Average of all other students	86.72	..

The student with the highest average in the senior class was Leslie J. Anderson. His average was 96.5.

The student with the highest average in the junior class was Joel M. Jacobson. His average was 96.8.

The student with the highest average in the sophomore class was Emil Blomme. His average was 94.8.

the freshman class was Alvin B. Auerbach. His average was 97.5.

Lecturer Makes "Unknown" Newfoundland Known

Armour students had quite a treat Friday, Dec. 14, when Robert M. Tait, editor of the "Newfoundland Weekly," delivered an address, accompanied by colored slides and motion pictures, on "Newfoundland."

Mr. Tait, a native of Newfoundland, was a Rhodes scholar, and also studied at King's College University. He saw active service in the late war, and was made a captain in the British army. He returned to Newfoundland in 1918, after being wounded. Mr. Tait is now a resident of Boston.

Newfoundland is not, as most of us think, a part of Canada, but is a separate colony, and has equal rights with Canada, New Zealand, and Australia in the British Empire. Within the last few years, Newfoundland was given territory in Labrador equal to more than three times its own size.

Newfoundland proper is a small island the size of New York State. Lakes and rivers cover one-third of the territory. The population is 263,000, dwelling mostly near the coast.

The main occupation has been fishing, but in recent years large companies have opened many paper factories, and rich mineral deposits have attracted American capital. A superabundance of unused water power promises future possibilities for an even greater manufacturing expansion.

If the motion pictures can be believed, the island is a veritable fisherman's paradise.

Mr. Tait left the impression that Newfoundland is not a cold barren waste, but a living active country that is forging steadily ahead.

Television Talk Draws Large Crowd

At a joint meeting of the A.R.A. and the A.I.E.E. a crowd of interested electricals, mechanicals, civils, fire protests, and chemicals overflowed Science Hall on Dec. 10. The attraction was a talk on "Television," one of the liveliest topics at the present time.

Mr. U. G. Sanabria, of the Carter Radio Corporation, presented the address. He is a Chicagoan, and although only 22 years of age has spent four years on television research. He is a noted authority on the subject. Complete apparatus was set up in the lecture hall, but as no transmission was permitted at that hour, no pictures could be shown.

Words

I did not know the shape and size
Of words I used on one occasion,
Until they met with other eyes
That took a love to be persuasion.
So what I meant and sent for good
Returned to me misunderstood.
And now I know that words require
The same respect I pay to fire.

—Walter Hendricks.

The principles of television were explained in simple terms and those present obtained a clear conception of the principles underlying radio transmission of pictures.

New Ideas Presented in Creative Thinking Speech

Thursday, Nov. 15, at a General Assembly, the students and faculty heard Dr. John Herman Randall talk on "Creative Thinking and How It Might Change the World." Dr. Randall is chairman of the World Unity Foundation and editor of the "World Unity Magazine."

The races and nations of the world, whether they like it or not, are so dependent on each other, economically and socially, that all should endeavor to obtain greater harmony and better understanding of other races and their problems.

Creative thinking results in familiar situations being considered in a different light. The result of world wide spread of creative thought would be a more common sympathy between nations, and the abolition of international strife.

Honorary Fraternity Conventions

The Fall of each year is the time when all the fraternities hold their national conclaves in various parts of the country. This year Armour chapter of Pi Tau Sigma, national honorary mechanical engineering fraternity, was fortunate in being the host to their convention, which was held at the Phi Pi Phi house, Nov. 2 and 3. Twenty-four delegates representing nine other colleges and members of the national council, were present. G. H. Smith and F. C. Theede were the Delta chapter delegates who planned the program for the convention. Registration took place Friday morning and the business sessions were held Friday and Saturday mornings. Friday afternoon Delta chapter's pledges were formally initiated, and Saturday afternoon the delegates witnessed the Chicago-Pennsylvania football game after which the convention was formally closed.

Tau Beta Pi, national honorary engineering fraternity, chose Washington University, at St. Louis, Missouri, as the scene of its national convention, this year Nov. 1, 2 and 3. J. W. Manz, president of the Armour chapter was sent as a delegate. As part of the business meeting four new chapters were taken in, namely, Clemson College, Miss. A. and M., North Carolina University, and Rose Polytechnic Institute. All the fifty-two chapters were present, besides the national president, and the national secretary-treasurer.

R. J. Guenther and V. A. Peterson represented the Armour chapter of Eta Kappa Nu, the national honorary electrical engineering fraternity, at the University of Minnesota, where Omicron chapter was host. The business sessions were held Nov. 2 and 3, the entire twenty-two chapters being represented as well as three alumni chapters. The Chicago Alumni delegate was Mr. G. H. Kelley, an Armour graduate of the class of '22. The twenty-fifth national convention will be held at Alpha chapter, University of Illinois, next year.

The biennial conclave of Chi Epsilon, national honorary civil engineering fraternity, was held at the University of Wisconsin, Madison, Nov. 3. The delegates witnessed the Wisconsin-Alabama football game before the convention had come to a close. An inspection of the new Memorial Union Building, in which the convention was held, proved it to be one of the finest buildings of its kind in the country. It was decided that the next convention will be held at the University of Minnesota in 1930.

The committee appointed to determine the circumstances attending the marriage of the average engineering graduate is still at work compiling statistics. They are pleased to announce at this time that after due investigation and deliberation they have awarded the honorary title of "Dean of Married Men" to Herbert E. Stier, '30. In the belief that Mr. Stier could be of material assistance in the carrying on of this investigation, they have enlisted his aid on the aforementiond committee; he will henceforth be listed on the staff of this publication.

NEW BOOKS IN THE LIBRARY

The following titles are among the books recently received in the Library:

BEARD, C. A., and others. *Whither Mankind.* 1928. A group of essays on modern civilization. The writers are all men of the present time—all moderns, and for the most part think and criticize from a very modern point of view, though giving due consideration to the events out of which our present conditions have so suddenly sprung.

BENET, ST. VINCENT. *John Brown's Body.* 1928. The whole story of the Civil war is here, from the raid of John Brown to Gettysburg. The poetic form changes to suit the particular theme.

BRIDGMAN, P. W. *Logic and Modern Physics.* 1927. The author, who is professor of mathematics and natural philosophy in Harvard University, discusses in a series of scholarly essays the purpose of physics and the nature of its fundamental concepts.

BROOKS, VAN WYCK. *Ordeal of Mark Twain.* Though it is several years since this volume was published, it is new here. Mr. Brooks wrote it offering a logical explanation of Mark Twain's tendency to pessimism. Much has been written about Twain but with the exception of Paine's biography this is the most essential, whether one agrees with it or not.

DE KRUIF, PAUL. *Hunger Fighters.* 1928. A record of the lives of some men whose researches have been of the greatest value in improving and increasing the yield of certain foods essential to man. Among them are Mark Carelton, founder of the durum wheat industry; Stephen Babcock, discoverer of the fat test for milk, and Joseph Goldberger, experimenter with yeast.

JONES, LLEWELLYN. *How to Criticize Books.* 1928. An interesting discussion for anyone interested in reading. It discusses among the other subjects rhetoric and the criticism of literature and biography. Tells lucidly and pointedly how one shall go about preparing a critical essay. Mr. Jones is literary editor of the *Chicago Evening Post.*

STARR, JOHN W. *One Hundred Years of American Railroading.* 1928. A story of railroad progress in the United States, told by describing individual contributions of inventors, road builders, engineers and financiers.

Sir Isaac Newton's tricentennial birthdate having been celebrated in 1927, the following titles are of interest to many: *Abro, A. d'. Evolution of Scientific Thought from Newton to Einstein,* and *Sir Isaac Newton, 1727-1927.*

Senior Archs in Beaux-Arts Contest

The first preliminary exercise for the twenty-second Paris Prize of the Society of the Beaux-Arts Architects, a contest divided into two preliminary and two final sections, will be judged January 17. The first preliminary exercise requires the solution of a problem in elementary design; the second, a problem in planning a large building or group of buildings. The finals consist of a preliminary sketch and a complete development and rendering of this sketch.

Five men and two alternates are chosen from the first preliminary to compete with twenty exempted candidates in the second preliminary exercise. From this eight go into the first final contest, and four of these go into the second and last final.

The prize is a two and a half year traveling scholarship carrying a purse of $3600 for expenses. While abroad, the winner must render at least ten regular projects in the "First Class" at the Ecole Nationale des Beaux-Arts in Paris.

Armour's senior architects have entered this contest, and at the time of this writing are anxiously awaiting the announcement of the first preliminary winners.

Honorary Fraternities

The Honorary fraternities have initiated their pledges and are now endeavoring to better their scholastic standings in a final drive before the first semester closes and the problem of selecting additional men who reach their standards again confronts them. This year Dr. Raymond established what we hope will be a precedent, in the form of announcing, publicly, at a General Assembly, the names of those men who have been newly initiated in the various honorary fraternities. This action, we believe will be an incentive for under-classmen to seek to take a more active part in school functions and to attain higher grades by earnest effort.

This semester forty-one men have become members of one or more honoraries.

The officers of Tau Beta Pi this semester are:

J. W. Manz.....President
John Hommes.....Vice President
Henry Christiansen.....Treasurer
R. J. Guenther.....Rec. Sec.
L. F. Bernhard.....Corres. Sec.
F. H. Juergensen.....Cataloguer

Tau Beta Pi initiates this semester were H. H. Dozois, N. S. Ewing, H. E. Goranson, M. J. Kittler, A. C. Meyer, H. C. Nissen, F. C. Ong, E. R. Rowley and R. F. Stellar.

The officers of Eta Kappa Nu this year are:

R. J. Guenther.....President
H. H. Dozois.....Vice President
A. C. Meyer.....Treasurer
N. S. Ewing.....Rec. Sec.
F. H. Juergensen.....Corres. Sec.

Initiates were F. H. Bigelow, J. C. Hromada, F. W. McCloska, C. J. McDonald, E. A. Michelson, F. C. Ong, M. A. Tennyson, and F. O. Zimmermann.

Pi Tau Sigma has as officers this year:

G. H. Smith.....President
F. C. Theede.....Vice President
J. W. Manz.....Rec. Sec.
M. J. Kittler.....Corres. Sec.
A. L. Barce.....Treasurer

Their initiates this semester were A. E. Neumann, H. C. Newman, G. C. Olson, A. L. Scully, C. G. Anderson, H. W. Faulstich, E. R. Rowley.

Chi Epsilon has as officers this year:

Henry Christiansen.....President
H. C. Nissen.....Vice President
R. F. Stellar.....Secretary
G. M. Montgomery.....Treasurer

Chi Epsilon initiates were F. B. Farrel, E. H. Mohr and G. A. Rezac.

Phi Lambda Upsilon, honorary chemical engineering fraternity, conferred membership upon I. R. Goldman, Seymour Goodheart, A. T. Martin, J. E. Tarman, W. R. Trognitz and E. P. Boynton.

Salamander, honorary fire protection engineering fraternity, lists as its initiates: W. H. Berry, J. W. Gamble, A. C. Gunther and R. E. Johnson.

Scarab, the honorary architectural fraternity, took into its folds D. L. Banta, Frank Polito, and W. N. Alderman.

Sphinx, the local honorary literary fraternity, welcomed four new men—F. B. Farrell, M. B. Golber, R. J. Guenther and A. J. Stabovitz.

Pi Nu Epsilon, local honorary musical fraternity, also accepted four new men F. J. Aste, J. E. Higgins, W. N. Setterberg and D. L. Williams.

Professor Named to Chaucer Staff

Professor Walter Hendricks has been appointed to the Chaucer staff at the University of Chicago. He is assisting Professor J. M. Manly, head of the department of English at the University, and a staff of editors in the preparation of the Definitive Edition of Chaucer. Professor Hendricks is Associate Professor of English at the Institute, and is the faculty adviser and original sponsor of the Armour Tech News, and a member of the Board of the ENGINEER.

Heretofore, Professor Hendricks has spent much of his spare time at the University assisting in the preparation of the American Dictionary under the direction of Sir William Craigie, who has charge of the work. Sir Craigie was the last of the three editors under whose successive direction the famous Oxford English Dictionary was prepared. The latter volume took forty years to complete and required millions of dollars in its preparation.

The American Dictionary, just as the Oxford Dictionary does for England, will contain a complete history of every word and expression in the American language, including slang and homely expressions, tracing their origin, their every conceivable usage, and shades of meaning. The work is expected to take many years.

In addition to his work at the University and in the English department at Armour, Professor Hendricks devotes considerable time to writing. He has already two books of verse to his credit, "Flames and Fireflies," and "Spires and Spears," and has under preparation a novel.

Survey Shows That Many Students Earn Expenses

In an effort to determine the number of students who earn, wholly or in part, the money to defray their college expenses, the Dean's office of the Institute recently distributed a questionnaire among the students. This survey has recently been completed and the results are here published.

The survey shows:

A. Students who earn all their expenses	31	3.8%
B. Students who earn part of their expenses by working during the summer vacation and the college session	340	41.8%
C. Students who earn part of their expenses by working during the summer vacation only	352	43.2%
D. Students who earn part of their expenses by working during the college session only	7	0.9%
E. Students who earn no part of their expenses	84	10.3%
	814	100.0%

Presumably those who earn all of their expenses work during both the Summer vacation and the college session. The total number of students who work during the college session is 378, or 46.5%. The total number of students who are earning all or part of their expenses, either by working during the Summer vacation or during the regular college session or both is 730, or 89.7%.

Undoubtedly, the above information will be of interest not only to the students and to the alumni, but also to the other engineering colleges, illustrating that a college of Armour's rank can maintain its high scholastic standing and yet have approximately half of its students work during the college session.

ALUMNI NEWS

W. R. Wilson Heads Aircraft Corporation

William Robert Wilson, '06, who recently resigned as president of the Murray Body Corporation of America, has become chairman of the board of the Great Lakes Aircraft Corporation, a new organization which has purchased the Cleveland property of the Glenn L. Martin Company, well known as a manufacturer of planes for the United States Government.

Mr. Wilson recently became the largest single stockholder of the Henney Motor Co., Freeport, Ill. The Henney Company has control of a majority of the common stock of the Great Lakes Aircraft Corp. Mr. Wilson is a member of the board of the Henney Co., while John W. Henney is president and Edwin R. Naar is secretary and treasurer.

The Great Lakes Aircraft Corp. will continue to manufacture Martin planes for the government as in the past, but will also develop a line of Martin designed planes for commercial work, plans being to go into production on commercial planes comparable in quality with the Martin 74 now in use by the U. S. Navy. It has acquired the physical property at Cleveland of the Glenn L. Martin Co., including the right to use designs and patents already developed by that organization.

The alumni office was pleasantly surprised by a visit from Robert S. Mayo during the first week of 1929. Bob graduated in civil engineering in 1923 and in the few years he has been out of school he has acquired a lot of practical construction experience in many different states of the Union. He is at present Erection Superintendent for the Blaw nex Company in the Pittsburgh district.

In his wanderings about from job to job, he reports having met Joe Wallace, '22, in Joliet, Illinois. Wallace is president and owner of the Joliet Engineering Company.

He also encountered Walter Treff, '26, in San Antonio, Texas.

One of our long lost alumni was discovered recently. At a meeting attended by some south side business men we met Walter J. McDonnell, '16. He has been engaged in the real estate business for several years in partnership with others, and a few years ago established his own company, known as the W. J. McDonnell Company, at 835 East 75th Street, Chicago. He is living at 6840 Jeffrey Avenue, Chicago, but reports that he will not be home for a while this winter because of a trip to Florida.

A. N. Jacobson, '14, who studied civil engineering while attending A. I. T., is now sales manager for the Stringer Brothers Company, Inc., located at 1160 West 38th Street, Chicago.

The total contribution to the Dr. Monin Memorial Fund now stands at $1,201.50, by reason of a check for $50.00 received from Leo F. Wormser. Mr. Wormser's contribution will raise the Memorial Fund which is available to needy students at the Institute, to $637.50.

In his letter accompanying the check Mr. Wormser wrote: "The spirit of this Fund, as I understand it, is one of helpfulness. Nothing could be more characteristic of the man whose name it bears."

The Armour Alumni Association is at present undertaking the publication of a directory containing the names of every person who has attended the Armour Institute of Technology, the Armour Scientific Academy, and affiliated schools, whether graduates or not.

The only directory which is in print at present is the list of graduates contained in the back of the annual bulletin and catalogue of the Institute. Since the opening of the Alumni office, the Association has been able to locate some thousand non-graduates who attended the Institute one or more years, and has now a file with the names and addresses of over three thousand of the Armour Tech Alumni. These names it plans to publish in the form of an Alumni Directory to be sent to every member of the Alumni Body.

The figure is not definite, nor available, but a careful estimate places the number of students enrolled at Armour since its founding as well over 8,000. Hence much work yet remains to be done before the list will be anywhere near complete.

Besides a list of the three thousand of whom the whereabouts is known, the directory will also contain the names of the remainder of the eight thousand who were at one time or another enrolled. The section devoted to these names will be by far the larger to begin with, although it is hoped that with the cooperation of active alumni, this section will decrease and the list of the actives will correspondingly increase.

The letter sent out by the secretary-treasurer in his annual call for dues brought answers from some alumni from whom we seldom hear. Louis W. A. Bunge, '15, wrote from California that he was very sorry that he was unable to attend any of the alumni banquets and meetings, but that he would make an extra effort to be with us at our spring banquet. He sent his regards and holiday greetings from 1245 Vine Street, Hollywood, where any of his friends who so desire may communicate with him.

Three of Seven Men

A folder came across the executive secretary's desk. It turned out to be very interesting from an alumni point of view. Across the cover are the words "Seven Men," and on the back cover a picture of the Allith-Prouthy Company.

The folder presented sketches of the seven men who had combined their natural talents and money into a directorship under which the activities of the Allith-Prouty Company and the Danville Malleable Iron Division are conducted. The first of these men is Donald E. Willard, president of the company. Mr. Willard received his degree of Bachelor of Science in mechanical engineering from the Armour Institute of Technology in 1905, and immediately started in as a draftsman with the Allith Manufacturing Company. After eleven years with the company, by this time known as the Allith-Prouty Company he left to help organize the Decatur Malleable Iron Company. In 1923, the latter company purchased control of the former and Mr. Willard again returned to Danville, Illinois, to become president of the Allith-Prouty Company while still holding the office of president and treasurer of the Decatur Malleable Iron Company.

The second man pictured is William S. Furry, vice-president of the Allith-Prouty Company. Mr. Furry was a graduate of the Armour Scientific Academy, and received his degree of Bachelor of Science from the Armour Institute of Technology in 1907. In 1909, he received his mechanical engineering degree from Armour Institute of Technology and has ever since been with the Ohio Injector Company of Illinois. In 1918, he was elected president of that company. He is also vice-president of the Ohio Boxboard Company and director in the Decatur Malleable Iron Company, Ohio Match Company, Ohio Salt Company, and Ohio Injector Company.

The third man among the "Seven Men" is H. A. Durr. Mr. Durr received his degree of Bachelor of Science in mechanical engineering at the Armour Institute of Technology in 1905, and received his mechanical engineering degree in 1910. He acquired his engineering experience with the International Harvester Company, S. G. Hobert, and Schmidt, Garden & Martin, architects. Having acquired sufficient engineering training and practice, he established himself as a consulting and designing engineer under the firm name of H. A. Durr & Company, in Chicago. He is a director in the Decatur Malleable Iron Company and the Allith-Prouty Company.

Received the marriage announcement of Dorothy Cleland McLane to Herbert C. Hoff on November 28, 1928. Hoff graduated from the electrical engineering department in 1926, and has been with the Commonwealth Edison Company ever since. Mr. and Mrs. Hoff are living at 32 Elmwood Avenue, LaGrange, Illinois.

LANDMARK PROVES VALUABLE

Many old timers will remember the huge rock alongside the Mission building on Feder Street, but it is doubtful whether any of them, and indeed any of the present undergraduates, know where it comes from. The following article is taken from the first issue of the "Integral," 1899, the predecessor of the present annual, the "Cycle."

"To Armour students, many of whom have passed by the large stone lying on the campus across the street from the Institute, it might be interesting to know that the stone is nickel-bearing and is the largest specimen known to have been mined and transported in a single piece. Its weight is nearly two tons. It was sent to the World's Fair, where it formed a part of the exhibit of the Canadian Copper Co., of Sudsbury, Ontario, Canada, which firm presented it to the Armour Institute of Technology at the close of the Fair.

"Sudsbury supplies nearly all the nickel used throughout the world, excepting that which is mined by the convicts of the French penal colony. The ore at Sudsbury is converted into a mass compound of nickel-sulphur which is shipped to the United States or Europe and refined, metallic nickel being thus obtained. Assavists tell us that aside from the nickel-bearing properties of this rock, it contains about eight hundred dollars worth of gold."

Henry Penn, brother of Dean John C. Penn, and former professor in the Civil Engineering Department, visited the Institute during the latter part of November. "Hank," as he is commonly known, was given an enthusaistic greeting by his former students, and true to form he gave a ten minute talk on the bracing of steel buildings against wind pressure. He seemed not to have forgotten his former status and sent a parting shot at his listeners to "stay around till five o'clock and don't leave early." At present Professor Penn is connected with the American Institute of Steel Construction.

Graduates of the Civil Department will doubtless wish they had available as comprehensive a course in aeronautics as is now planned. The aeronautical option in the senior year of the Civil Engineering course hase been remodeled so as to accommodate the ground school requirements for the Naval aviation training. This option covers the same subjects as the ground school course being given to the night school students at the present time, and in addition, much more comprehensive with respect to theory and design. Commencing next year, the navy requirements will be raised to a standard commensurate with the new civil aeronautics option, which condition will probably limit those who qualify to upper classmen in engineering colleges, or to graduates. The night school course will be adjusted to include the new requirements.

Fifteen men will make up the quota from Armour for the aviation training offered by the navy. These men will be chosen from both day and night school classes. This training includes one month of preliminary flying at the Great Lakes Naval Training base, and eight months intensive training at Pensacola, with a compensation of eighty-four dollars per month.

Mr. Ralph W. Hammett, Associate Professor of Architectural History, was married to Miss Gladys Brouillard of Minneapolis on November 10.

Walter L. Juttemeyer, '15, a graduate of the mechanical engineering department, was a recent visitor to the Institute. He is master mechanic with the Aluminum Ore Company of East St. Louis, Ill.

Mr. Richard D. Ruddock, C. E. '26, of 213 Center Street, Wheaton, Illinois, an employee of the Cook County Highway Department, was killed in an automobile accident near Joliet, Illinois, on Sunday evening, December 16. Mr. Ruddock's untimely death was a shock to his friends and is grieved by those at the Institute. He was a member of the Delta Tau Delta fraternity.

A Philosopher

To take things as they be—
That's my philosophy.
No use to holler, mope, or cuss—
If they was changed they might be wuss.

If rain is pourin' down,
An' lightnin's buzzin' roun',
I ain't a-fearin' we'll be hit,
But grin that I ain't out in it.

If I got deep in debt—
It hasn't happened yet—
And owed a man two dollars, Gee!
Why, I'd be glad it wasn't three!

If some one come along,
And tried to do me wrong,
Why I should sort of take a whim
To thank the Lord I wasn't him.

I never seen a night
So dark there wasn't light
Somewhere about if I took care
To strike a match and find out where.

—*John Kendrick Bangs.*

Herbert H. Chun, E. E. '25, recently made known an invention of a new device which subjects radio tubes to simultaneous electrical and mechanical tests, simulating the severest usage. Chun is a radio engineer with the Arcturus Radio Company, manufacturers of A. C. tubes.

Tubes that pass the usual mechanical and electrical inspection frequently go bad under the strain of shipment and rough electrical usage. The mechanism designed by Chun consists of a special test rack vibrated by a cam, while at the same time the tubes are turned on and off by an automatic switching arrangement.

Chun has a younger brother, Edmund H. Chun, who is now a junior in the Civil department.

Frank J. Pischke, E. E. '28, has been in the Chicago Testroom of the A. T. & T. Co. for about three months. He worked days until about a week ago, and is now working from 7 P. M. to 12 midnight. He is regularly employed to measure some of the New York cables and to line them up suitable for commercial use.

NEDVEDS JOIN ARCHITECTURAL FIRM

Professor Rudolph James Nedved, '21, and Mrs. Elizabeth Kimball Nedved, '25, both graduates of the architectural department, were recently made active partners in one of Chicago's oldest architectural firms. This firm was formerly known as Hamilton, Fellows and Wilkinson, but is now rechristened as Hamilton, Fellows and Nedved. L. E. Wilkinson has retired from the firm and will practice architecture in the east, specializing in churches. Mr. and Mrs. Nedved will be engaged actively with a new department of the firm, that of residences.

Professor Nedved graduated from the Institute in 1921, and traveled in Europe after winning the Chicago Traveling Scholarship. In London he met his future wife, Elizabeth Kimball, the daughter of Mr. and Mrs. Ernest Kimball of Glencoe, Ill. Upon returning to the United States in 1924, Professor Nedved became connected with Tallmadge and Watson, church architects; and later with Schmidt, Garden and Erickson. Professor Nedved was president of the Architectural Sketch Club and also of the Architectural Exhibition League for two years.

While traveling in Europe, Mrs. Nedved made a great many water color sketches which she has exhibited in the International Water Color Show, the Chicago Artists' Exhibition, and the Chicago Architectural Exhibition. Mrs. Nedved was the first woman member of the Chicago chapter of the American Institute of Architects.

Professor Nedved has been connected with the Architectural course at Armour since 1924, and for the last three years he and Mrs. Nedved have practiced their profession in the Marquette Building.

Clarence Vander Molen, '28, believes that there is always just as good an opportunity to succeed right in the old home town as anywhere else, and accordingly has located with the firm doing the municipal engineering for Hinsdale, Ill. Laying out nice straight streets is part of his job.

Several inquiries have been received asking the identity of the young lady whose picture appeared in this section the last issue. In answer to these we state here that the young lady is not, as was seemingly implied, married to any of our graduates, at least not yet. She merely posed for that picture in such raiment on request. Because this will probably provoke further inquiries, we shall be prepared to handle same, or call or communicate with the Alumni office, 3300 Federal Street.

Professor Thomas E. Tallmadge, Lecturer in History of Architecture to students in the Architectural Course, Fellow A. I. A. of Chicago, and member of the local architectural firm of Tallmadge & Watson, has been appointed a member of the commission of architects to advise on the restoration of the city of Williamsburg, Va., to its original form, according to the Leaflet, published by the Chicago Chapter of the A. I. A.

Four million five hundred thousand dollars has been donated by John D. Rockefeller, Jr., to rebuild and remodel the Virginia community back into its colonial atmosphere. The commission consists of eight members, of whom Professor Tallmadge is the only Chicagoan.

THE ROOT OF TECH.

IT'S "SQUARE."

Our ideas are like bad pennies and we spend our lives in trying to pass them on one another.—Samuel Butler.

THE IMMIGRANT

"Next!"
"Who, me?"
"Born?"
"Yes, sir."
"Where?"
"Russia."
"What part?"
"All of me."
"Why did you leave Russia?"
"I couldn't bring it with me."
"Where were your forfathers born?"
"I only got one father."
"Your business?"
"Rotten!"
"Where is Washington?"
"He's dead."
"I mean the capital of the United States."
"They loaned it all to Europe."
"Now, do you promise to support the Constitution?"
"Me? How can I? I've got a wife and six children to support."

—*Open Road.*

It is said that many a true word is spoken through false teeth.

When an airplane comes down, it is quite probable that it will go up in smoke.

BOOK REVIEWER'S SALE

Best of fiction books on sale; most have never been read.

A light circuit may mean a heavy current.

A new high-water mark was reached in Florida real estate recently.

Voice from the eleventh floor: "Smatter down there? Have you no key?"

Noisy one on the pavement: "Gotta key all right, but wouldja jussasoon throw down a few keyholes?"

—*Boston Beanpot.*

In a lecture the other day the Professor was sure that "only a fool is positive."

A Scotchman always rides in summer because the rails are longer.

HELPFUL HINTS FOR FRESHMEN

A bump on the crazy bone won't show under a hat.

If someone sent you spats for Xmas, have them half-soled.

Riding in the patrol wagon is perfectly alright in a pinch.

Many a motorist had to have his wholesome fun; now he rests in pieces.

JUST SUPPOSE

If all that we say
In a single day,
With never a word left out
Were printed each night
In clear black and white,
Twould prove queer reading, no doubt.
And then just suppose
Ere one's eyes he could close
He must read the day's record through;
Then wouldn't one sigh
And wouldn't he try
A great deal less talking to do?
And I more than half think
That many a kink
Would be smoother in life's tangled thread
If one-half that we say
In a single day
Were left forever unsaid.

—*Author Unknown.*

He told her that he was burning with love for her, but she told him not to make a fuel of himself.

The most annoying place to live is just beyond your income.

Chief Clerk (loftily): "Now, just what would you do if you were in my shoes?"

Office Boy: "Take 'em off before I tripped and broke my neck."

Author: What do you think of my story?

Editor: I believe I'll never read its sequel.

AN EMBARRASSING MOMENT

Wee Willie was taken on a visit to a rich aunt that lived in the city. He spied a statue of a freckless damsel and suddenly yelled, "Oh, Daddy, that lady's hasn't got a ———."

"Hush up," said the pater.

"But Daddy," continued Willie, "that lady hasn't got a ———."

"Shut up," cried the blushing papa.

"Daddy," whispered Willie, "that lady hasn't got a bracelet like mama has."

The hot dog industry is making both ends meat.

A confession magazine pays all the "wages of sin."

You may not know what to do when you are getting seasick, but you'll do it anyway.

Modern gasoline is quite weak. In olden days the Spaniards would go 2,000 miles on a galleon.

JUST BEFORE THE STORM

This: "My girl's posing for a beauty ad run by the Nued Cream Co."

That: "Before or after?"

Heroes of history have helped the students by dying in their last battles. How much harder it would be if it happened in the third or fourth.

She wrung her hands when she found that the doorbell was out of order.

"The stone-cutters union got rid of Green."

"How come?"

"He took too much for granite."

Bright Sayings of Freshmen:

"Divide it in the middle, twice, in two parts."

"The whole beam partially is lifted up entirely."

"Make that line a little more less."

BITS OF WIT

Collegians are using the European style of debt paying, nothing down and the balance cancelled.

The water in our milk is fine; it's thrown in for good measure.

They place the trolley on the rear of the car because the motorman is a non-conductor.

Then there was the Scotchman who wasn't so tight; he was dead.

The hatless collegiate strengthens the theory that where there is no sense there is no feeling.

His best friend wouldn't tell him so he flunked the course.

She was only a professor's daughter, but she couldn't help it.

And when we die we'll make it hot for the others.

Prof.: Do you understand this, Smith?
Student: Yes.
Prof.: Then I think the rest of the class does.

Apologies to *The Slipstick*

Every little wind that blows
In the winter, will expose
Regions fair, unmarred by hose.
While in the balmy summer breeze
All the close observer sees
Is rayon, silk, perhaps bare knees.

B. H. R.

Putting two and two together gives you a bridge game (at any fraternity house).

RECIPE FOR A HARD DRINK

Freeze a quart of water until it's ice and hard.

The Scotchman adds a postscript.

P. S. I have the five dollars I owe you, but have already sealed the letter so I can't get it in.

"What's the difference between a plumber and an Economics Professor?

"I'll bite—what?"

"A plumber doesn't pretend to know anything about Economics."

IF ALL

If all the boarders in the United States were seated side by side, they would reach across the table.

If all the automobiles in the United States were placed end to end, it would be Sunday.

If all the New Year's resolutions just made were put together, they would hardly reach February 1.

How many young ladies placed end to end would it take to reach from Chicago to New York?

Well?

Approximately one thousand—a miss is as good as a mile.

We suggest that the Seniors have a true "Engineer's Menu" for their banquet. The following contains plenty of food for thought for any kind of engineer:

Menu

Rivets on the Boiler Shell — Exhaust Cutoff Bivalves

Soups

Puree de Stay Bolts — Creme de Iron Filings
Bouillon de Steam Trap

Hot Dishes

Hot Boxes, Plumbago Sauce — Hot Grate Bars with Clinkers
Joint of Pipe stuffed with Steam — Boiled Flues, Scale Dressing
Spring Frogs with Wintergreen — Scrambled Boiler Heads
Planked Fish Plates — Scalloped Amperes with Potential Sauce
Leg of Aniline with Condensers

Cold Dishes

Cold Rolled Steel — Chilled Wheels — Cold Chisels
Methyl Bread — Rolling Mill Rolls — Dry Toasts

Relishes

Pickled Castings — Preserved Volts — Grated Emery Wheel

Desserts

Lubricators — Hexagon and Jam Nuts — Iced Steam
Creme de Leakypoint — Door Jam

Drinks

Condenser Water — Feed Water — Lathe Drippings
Unfermented Pump Juice

Most likely, the dry toasts will be served after the meal.

We clip the following for the benefit of those who doubt the power of the press:

"Owing to the overcrowded conditions of our columns, a number of births and deaths were unavoidably postponed this week."

One Eastern railroad has a regular form for reporting accidents to animals on its right of way. Recently a track foreman had the killing of a cow to report. In answer to the question, "Disposition of carcass?" he wrote: "Kind and gentle."

Contentment is eight parts laziness.

OH—MY CALCULATIONS!

The other day not long ago
I took a quiz, and now I know
That every form I used that day
Was just the thing, and quite O. K.
But Oh—My Calculations!

I met a girl, and she's so sweet
She nearly swept me off my feet.
I calculated she'd be mine
If only I had half the time.
But Oh—My Calculations!

I'm married now, and here to tell
It sure is just a living—Well,
Anyway I sure do rate
Cause now the fam'ly's swelled to eight.
Now D—n Those Calculations!

B. H. R.

Many a pardoned prisoner is lucky that there is a Sanity Clause.

Some of these cigarette ads are a Blind Man's Bluff.

A NEW HEIGHT

A ship-builder recently christened a baby.

"How come you were born in Ireland?"
"Well, you see, I wanted to be near my mother."

—*Annapolis Log.*

These silent men at the pep meeting would help along if they kept their mouths open to resonate the weak cheers.

Marriage is the cause of all these divorces we hear of in the papers.

Senior: Have you heard the barber college yell?
Junior: (Of course he says no.)
Senior: Next!

When first he knew her, she was smiling at him. They were married, and now she's smiting at him.

The engineers of the trains going by believe in justice. They'll give you a toot for a toot any time of the day.

A boob is a boob from one end or the other.

He heeded not the traffic cop,
He raced ahead pell-mell;
The doctor told the sexton
And the sexton tolled the bell.

He (smothering her with kisses): Darling, do you know that I love you?
She: Well, I'd certainly hate to think this was your way of behaving in company.

. . . an empire hung on that strap . . . .

STAGE LIGHTING

(*Continued from page* 53)

of footlights have individual reflectors with gelatin color screens.

At least four and preferably five circuits should be provided for the footlights so that red, green, blue and white light are available, with a fifth circuit for amber, although commonly amber is made by mixing red and green, while all other colors can be made with the other three fundamentals. The footlights should be divided up into two or three sections across the stage, so that different colors may be thrown on different sections of the stage.

The border lights furnish general illumination from a natural direction, that is, overhead, and are therefore a necessary part of stage equipment. The number of sets to be used depends on the depth of the stage, some theaters having seven or eight rows. The size of lamps used ranges from 25-watt to 100-watt in the average theater and 1000-watt in large show houses. The old style border has the faults of improper distribution of light, low efficiency and the mixing of color, just as in the old types of footlights. The newer types have individual reflectors which control the light and make it possible to get greater illumination for the same wattage. Gelatin screens are also used in this work and care must be taken to have suitable holders so they will not be knocked out of place as the drop is being raised or lowered. In certain cases it is desired to control the border lights to a greater degree than obtained through lens equipment and there are borders in use which are virtually rows of small spot lamps with concentrated filament lamps and remotely controlled color filters.

The same number of circuits should be had in the borders as there are in the footlights, to provide flexibility of their operation. These borders should be capable of being raised or lowered as necessity may demand, but they are generally located about twenty feet above the actors' heads.

Proscenium and strip lights are virtually border lights hung in vertical positions, and run from the floor up to about twelve or eighteen feet. The purpose is to assist in reducing the sharp contrasts which might appear in the vertical plane, and there are usually from 100 to 150 watts of each color per foot along the sides. There are now many individual reflector and lens lamps being successfully applied to this service.

A very useful device for lighting a given area to a greater intensity than the rest of the stage is the bunch light. Hand fed arc lamps are the old style, but with the production of 1000-watt lamps, these are now being used. Spun aluminum or white painted reflectors are generally used, although for more accurate control mirrored glass is used, and gelatin screens provide color modifications. The advantages of these lights are that they are adjustable as to height and direction and are also portable. Remote control is also an advantageous feature, as these lamps can be dimmed and otherwise controlled from the switchboard, which reduces the number of operators.

When it is desired to draw the attention of the audience to a certain actor or piece of the setting, it is customary to illuminate this area to a very high intensity of light by means of a spotlight, which directs a strong concentrated beam. The highest intensity is obtained with the direct current hand-fed arc, but in most cases the 1000-watt lamps are satisfactory, if they have a spherical mirror behind the filament. The spot can be enlarged or decreased and its direction changed so that an actor can be "followed with the spot," while color modification is obtained by either the color wheel or by gelatin screens. Some very beautiful effects can be produced by using the very intense spot on a moderately lighted field of view. In some cases overhead spots are used, which eliminate the defined spot on the drop, but produce natural shadows which are very harsh.

BE not haughty because of thy knowledge; converse with the ignorant as with the scholar; for the barriers of art are never closed, no artist possessing that perfection to which he should aspire.

—Ptah-Hotep (3500 B. C.)

It is possible at the present day to produce by light many such effects as running water, falling rain or snow, moving clouds, flames, fireworks, sandstorms, rainbows and innumerable special illusions. An effect such as a rainbow is obtained by reflecting a pure white light through a prism upon a white screen which is bathed in a soft pale blue light, representing blue sky. Other still scenes such as interior and exterior can be shown on a white screen instead of painted. Moving effects such as clouds, rain, snow, sandstorms are produced by a special head containing a painted revolving disk which is driven by an adjustable speed motor or by clock work. In some cases, to produce cloud effects, two groups of lens systems which project pictures of clouds are centered around a powerful light source. The entire mechanism is rotated, and, by means of motor driven mirrors, one group of images is made to pass over other groups at various speeds, giving depth and realism to the picture. A section of motion picture film showing breaking waves has been used in a powerful motion picture projector for simulating the dashing surf. Flame effects used to be produced by throwing red light on rising steam, but now a patented device is used whereby light is shown on thin strips of silk set in motion by currents of air.

Aside from all of the lights necessary on the stage, it is very important that there be stage pockets on both sides, front and back of the stage. Each stage pocket should contain more than one socket and be capable of carrying high currents controlled by dimmers and switches at the switchboard.

The switchboard itself should be located in such a position that the operator can view the entire stage at all times. The equipment consists of some type of dimmer for each circuit and also switches for each circuit. There are three ways of dimming a light, by increasing the resistance of the circuit, by decreasing the voltage, or by increasing the reactance. The first two can be used both on alternating or direct current, while the third can be used only on alternating current circuits. The increase in resistance and reactance are the only ones in general use, and although the resistance method is the most popular, the reactance method is coming into favor. The resistance dimmer is just a coil of high resistance wire tapped so that fine adjustment can be had and the illumination reduced gradually. The reactance type in its simplest form is an iron bar inserted into a coil through which the circuit current is flowing. The iron bar tends to increase the inductance of the coil and also the reactance of the circuit, thereby limiting the current. It should be remembered that in any installation, for safety sake, the switchboard should be all dead front, because the operator must work fast in order to watch both the scene and the board, and most of the time he has his back to the board. For convenience it is proper to have the color dimmers marked with their respective colors.

It is also necessary to have one or more large switches known as "company switches," as there are many productions which carry their own

lights and switchboard with them, and only use the house apparatus for the auditorium lights.

Stage lighting has not been developed to its full extent and there is much to be done in this rather new field. Each day the producers and managers are realizing more and more the importance and value of proper lighting of the stage, and it will not be very long before the proper lighting will be considered the paramount object in any production. Almost miraculous creations are being made by the simple lighting method, and it is difficult to prophesy new developments.

THE BUREAU OF STANDARDS

(*Continued from page 47*)

turing process. Frequently such work cannot be carried out in a commercial plant. In some cases commercial machinery is used, while in others, as illustrated by the paper mill, the machines have been specially designed. These plants enable the Bureau to study carefully the actual process by which materials are manufactured, and often it is able to suggest improvements which lead to better and cheaper products. New uses for materials are discovered and outlets found for waste products. Paper has been made from all sorts of materials, such as cotton linters, sugar-cane refuse, banana stems, etc.

The durability of United States paper currency has been increased more than 50 per cent by the development in the Bureau's experimental mill of an entirely new type of paper. Although the paper is unlike any ever before produced, it can be manufactured in existing plants and is no more expensive than the former material.

The Bureau's work, just now getting well under way, on the utilization of waste products of the land is performed by this division. A satisfactory grade of wall board is being manufactured from cornstalks in a semi-commercial plant erected by the Bureau and Iowa State College at Ames, Iowa. Peanut shells have been used with some success as a substitute for hardwood shavings in the manufacture of gypsum fiber concrete. Xylose, a rare sugar, at present selling for $100 per pound, is to be produced from peanut shells and cotton seed bran on a semi-commercial scale at a plant which the Bureau and the State of Alabama are erecting at Anniston, Ala. It is believed that xylose can be produced in this factory at not over fifty cents per pound, and if so, this sugar will find important industrial applications.

The Metallurgical Division is equipped to go through all the processes employed in the casting, working and heat treatment of metals. There is an experimental foundry, equipped with gas, oil and electric furnaces, rolling mill, forging press, draw bench, heat-treatment plant, etc. These machines are of medium size and capable of doing some real work. Very complete equipment is provided for the microscopic study of metals, and recently the X-ray has been taken up as a means for studying the internal structure of metals and alloys. In no industry are high standards more dependent on exact scientific work than in metallurgy, yet for years most of the processes were controlled by the "rule of thumb" methods. The Bureau is devoting much attention to rail failures and ways for preventing them. The Bureau is cooperating with the steel makers and the railroad companies on these problems, which involve hundreds of test on new rails and ones which have been subjected to varying lengths of service.

The prevention of corrosion of duralumin, the light alloy used in aircraft construction, has been studied, and it has been found that by proper heat treatment and by coating the duralumin with a layer of pure aluminum corrosion can be largely eliminated.

Passing now to the last of the divisions housed in the Bureau's plant, we may consider as typical of the work of the Ceramics Division that on optical glass. Before the war not one pound of optical glass was made in this country. American lens makers led the world, but they all worked with German or French glass. When the war came, the foreign supply of glass was cut off, and our Army and Navy were threatened with a shortage of all the optical instruments which are absolutely essential to modern warfare. Dr. W. W. Stratton, who was then Director of the Bureau, realized the danger of the situation, and processes for making optical glass were developed at the Bureau in cooperation with the Geophysical Laboratory and with manufacturers. The whole difficult technique had to be developed, but in 1917 we were able to produce the highest grades of optical glass, and we have been making it ever since. Most of our glass now goes to the Navy Department and is used in gunsights, periscopes, range finders, officers' binoculars, etc.

This section has just completed the casting of the largest piece of optical glass ever made in this country, and one of the three or four largest in the world. This is a disk of glass 70½ inches in diameter and 10½ inches thick, weighing about 3,500 pounds. It will be used as the mirror for the reflecting telescope at Ohio Wesleyan University. Eight and a half months were required for cooling and annealing, and over 70 hours for drilling an 8 inch hole through the center of the disk. This Division also deals with chinaware, heavy clay products, refactories, cement and concrete, lime, gypsum, and enameled ware. New uses have been found for American clays, and waste in these industries through defective ware has been greatly reduced.

The Bureau tests samples of all the cement which the Government buys, and to expedite this work, three branch laboratories are maintained, at Northampton, Pa., Denver, and San Francisco. The advisability of somewhat extending the work of these laboratories, particularly at San Francisco, to assist Government agencies and the States in the vicinity is now being considered.

In accordance with the Organic Act of the Bureau its services are available without charge to the National and State Governments, and it is in following out this provision that the Bureau acts as the principal testing laboratory of the Government. As previously mentioned, the Bureau's Director is Ex-officio Chairman of the Federal Specifications Board, which has done much to unify Government purchase requirements and much of the testing for the board is performed by the Bureau. In the case of private tests, nominal fees are charged, but these fees are not available for the support of the Bureau's work. They are turned into the United States Treasury. The Bureau is, therefore, dependent upon the appropriations made by Congress and a comparatively small sum transferred by other Departments for the maintenance of its activities.

The results of the Bureau's work are made available through its monthly Journal of Research, circulars, and other publications, a monthly Technical News Bulletin, by articles in the scientific and technical press, and by short items in the newspapers.

Every effort is made to keep in mind that the Bureau of Standards is a public service organization, and it is therefore the Bureau's policy to give as wide publicity as possible to any worthwhile results growing out of the work. Many improved devices and processes now in extensive use have originated in the Bureau's laboratories.

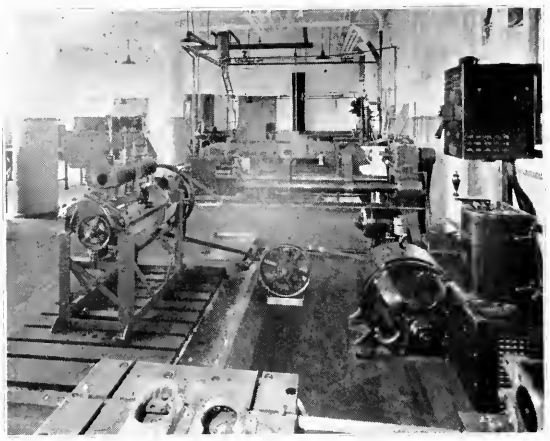
AUTOMOBILE TESTING

(*Continued from page 51*)

engine power and efficiency. The methods of measurement do not differ radically from any others in use. A Sprague electric dynamometer is used to absorb the power generated by the engine. The torque is weighed upon a suitable scale and the number of revolutions per minute is measured with a tachometer in order to check power. If there is any distinctive thing about the dynamometer layout, it is the fact that they are arranged to be operated by one man only and everything is laid out for his convenience. By far the greater proportion of the work in the Power Plant Laboratory consists in making certain changes in the engine structure or its accessories and determining the resulting changes in power and efficiency. In order to do this economically, it is desirable to have all the instruments so grouped that one man can take all the necessary readings, and to take these readings rapidly. This is what has been attempted in our typical dynamometer layout.

The torque scales are included in the equipment furnished with the dynamometer. Two sources of fuel supply, one an anti-knock gasoline, the other a standard fuel, are available, both feeding the carburetor through a gasoline flow meter which is calibrated in pints per hour and has six scales so that it is possible to read with a high degree of accuracy in the particular range of fuel consumption in which we are working. The rate of water circulation and the inlet and outlet water temperatures of the motor are important from the standpoint of thermal efficiency, so these instruments are also mounted at the operator's board.

Another unusual and interesting piece of apparatus is the chassis rolls or bumping rolls. The development of this apparatus was a result of reports that American cars, our own included, were showing failures of certain parts in service in Europe, particularly in France and Belgium, which were never encountered in domestic car parts, but it was evident that there was some set of conditions that were extremely severe in European service. This was found to be the type of road then in use. The European roads, with the exception of England and Switzerland, have been badly deteriorated by war traffic and due to economic conditions it has not been possible to restore them to good condition. As a result of rough road condition, such as Americans would not consider driving over, but over which the Europeans drive with considerable speed, the bumping rolls were designed to develop a condition which would duplicate these European roads that we were unable to find in America and which would have been severe on our test drivers had we been able to find them. These rolls have a series of 1½-inch depressions in their peripheries at uneven intervals. The car is run on these rolls with an attachment which alternately opens and closes the throttle so that it passes through a very severe period, during which the entire car is racked by severe vibrations of a frequency comparable to or greater than those encountered on the European roads. The power supplied by the rear wheels of the car is transmitted by belts to the rolls which drive the front wheel. Under these severe conditions, it was surprising to know the number of things that could be broken, loosened or shaken off of the cars when first tried on the bumping stand. After a few months of operation, we were able to materially increase the life of certain important parts as a result of the tests on this machine.



The shock absorber life test machine for testing and developing different makes of shock absorbers.

In order to accurately study distribution, valve timing and combustion characteristics, a Jacklin high speed multi-cylinder engine indicator is used. This indicator utilizes the conventional steam engine indicator by means of an ingenious valve and speed reduction mechanism, which practically eliminates pencil and drum inertia at high speeds. The indicator is connected to the crankshaft by positive drive and a small poppet valve is opened for a small interval of time in each cycle of the engine, so that a very small amount of gas may pass into or out of the indicator cylinder in order that the pressure may become balanced. It requires 800 cycles of the engine to give a complete diagram, so that at 1600 r.p.m. the indicator makes a complete diagram in one minute. The diagram is then a composite one and not just the diagram of one cycle, so that an average diagram is made on one card. The pressures are built up and let down in small increments while the card is moved back and forth at a very low speed. Thus, except where the pressures vary greatly from cycle to cycle, there is very little inertia entering into the motion of the pencil mechanism of the low speed indicator. Nor can any inertia be present in the operation of the drum, since it moves at very low speed. By the use of light springs on the indicator, accurate lower loop diagrams can be made to study the effect of valve timing and with heavy springs the complete diagram can be taken to determine the combustion characteristics which in turn influence the output of the engine.

The Electrical Department covers a wide range of experimental work which is divided into three major classes, namely: electrical devices, automobile accessories and refrigeration problems.

Electrical units developed and tested by this department comprise a list of equipment including starting motors, generators, ignition devices, storage batteries, switching elements, in addition to the distribution network necessary for their operation. The methods of developing and checking these parts from production do not differ materially from those followed in other departments and consequently will not be elaborated on further.

The accessory division includes vacuum tanks, speedometers and various other units, in addition to gauges, which appear in the instrument panel.

Quite frequently in approving the merits of a particular design, there

is an advantage in testing at various degrees of temperature. To fulfill this requirement, a completely equipped cold room is available for this use. In this room, temperatures as low as 20° below zero may be maintained for indefinite periods. Actual conditions may be further duplicated by the action of a blower which circulates air through the room at speeds up to 40 m.p.h. The size of the room is such that a complete car may be accommodated in addition to other testing equipment, including an engine dynamometer stand.

In connection with the main cold room is a super cold room of smaller size, where temperatures as low as 60° below zero may be obtained. The principle purpose of this room is to make possible studies of material strengths and elasticity properties.

The Materials laboratories have a double function. The first is the establishment of the quality of materials entering into the construction of car parts by development of suitable process and material standards. This is primarily experimental and research responsibility. The second function is to check incoming production materials to see that these materials meet the specifications which have been laid down. The laboratory is divided into three major divisions: the Physical, Metallurgical and Chemical Laboratories.

In the salt spray room of the Chemical Laboratory, protective coatings are given a test to check their efficiency. For example, chrome-plated parts are required to withstand the action of the salt spray for fifty hours, without showing signs of rust. A part which will stand this test will give satisfactory service under normal conditions.

Another interesting piece of equipment is that for the ultra-violet light test. The ultra-violet ray is the active ray of sun causing sunburn, fading and bleaching. The test apparatus generates ultra-violet rays in a sealed quartz tube. It is used for accelerated fading tests of top and upholstering materials, paints, rubber, etc.

The fuel laboratory is another division of the Chemical Laboratory, and its purpose is to test motor oils, fuels and greases. In addition to experimental work, samples are taken from incoming shipments and examined before the cars may be unloaded.

The Metallurgical Laboratory equipment includes an electric furnace, where temperature is automatically controlled and recorded. The various steels are heat-treated experimentally in order to arrive at the proper procedure to be used in production heat treat departments. Structures of steels are also studied in this department.

Typical machines of the Physical Laboratory are two large tensile testing machines and a torsion machine. In these machines the test sample is either pulled, compressed or twisted until failure occurs. Weighing devices on these machines give the exact load applied and amount of deformation of the test specimens.

The high speed centrifugal testing machine in this laboratory is an unusual piece of apparatus and receives considerable interest when tests are being run. It was designed to find the bursting speed of rotative car parts by rotating up to a speed where failure occurs. The apparatus has been used for flywheels, clutch assemblies, crankshaft counterweights, fans, etc. The part to be tested is mounted on the shaft of the machine in a specially constructed pit. Although this pit is made of reinforced concrete and lined with 4x4 inch oak, broken pieces often pierce the oak and become embedded in the concrete. The test has made it possible to increase the strength of several rotative parts up to 100 per cent. It has also been very valuable in determining the safety factor of new designs.

The research division differs materially from all laboratories in the Engineering Department in that it is devoted exclusively to the development of new ideas which are in advance of conventional design. The laboratory is available to the Research Engineer for solving the problems that previously have remained unsolved. All work pertaining to improvements of present models or solving of production problems are assigned to other departments, in order that the research division may follow through its work without interruption.

Fully equipped radiation, rubber, electrical and metallurgical laboratories are found in this division, in addition to a studio for use of artists in studying the appeal of various body designs departing from conventional practice.

From the foregoing paragraphs the reader may have obtained the impression that road work has little value. As a matter of fact, the actual importance of road testing cannot be overstressed. In this department the final tests are conducted that often furnish the deciding information for approval or disapproval of an experimental construction. In addition to this function, many conditions of service are so complicated that it would be impracticable to attempt to duplicate them in the laboratories. Testing practice of this nature must by necessity be confined to the road department. In this capacity a number of cars are maintained for the extensive experimental work necessary to develop a new construction to its final form and dimensions. After this has been accomplished, the unit is then installed on a road car along with other experimental parts which may have been developed either in the laboratories or on cars. This car is then assigned to two drivers who have the responsibility of keeping it on the road night and day, stopping only for service. The driver's object is not merely to obtain mileage, but to drive over every kind of road surface, level and hilly, from low to top speed. In fact, the

car is given the same kind of service that an owner might give his own car to a lesser degree. At the end of each shift, the driver fills out a detailed report which covers the performance of every part of his car. In this way, an engineer who has requested an installation is kept informed constantly of its merits or defects as mileage increases.

Another function of the road department is the periodic checking of production cars to ascertain that production cars have the same performance and endurance characteristics as that of the original experimental units. These cars, which are picked at random from production, are driven under the same conditions as the experimental cars, with the exception that the driver is not allowed to make adjustments. These cars are also used for standard performance tests, including economy, oil consumption, acceleration, maximum speed, etc.

In concluding, it may be of interest to the engineering student to know that, in general, there are so many variables involved in the design of an automobile part that the final solution cannot be obtained entirely by computation without supplementary experimental work. For this reason, the Engineering Department has adopted the policy of withholding final approval of every new construction until its merits are definitely proven by actual test.

COLORED MOTION PICTURES

(*Continued from page 49*)

with the little lenses faces the camera lens.

The special color filter used is merely striped with the three colors, red, green, and blue, and is inserted into the camera with the three stripes running in the direction of the passage of the film through the camera; that is, parallel to the little lenses molded upon the film.

When an exposure is made, light coming from the object passes through the three-color filter, on through camera lens, and then through the small cylindrical embossed lenses on the film itself to the light sensitive silver compounds contained in the emulsion. Of all the rays emanating from the object, the red area of the color filter lets only the red pass through, the green lets only the green through, and the blue area passes only the blue light. Since each color is to make its record upon the film, it is absolutely necessary that panchromatic film be used.

These rays of light emanating from every point of the object are thus separated or shut out from the camera according to their color. Those colored rays that pass through are each focussed on that part of the film that corresponds to the part of the subject from which they came. Now the cylindrical lenses on the film do their work. If these lenses were not there, the rays representing the three colors would converge on the sensitive emulsion as a single point and there would be no differentiation of the colors. The little lenses, however, so guide the rays falling upon each tiny area of the film that they are laid upon the emulsion in an orderly fashion as three distinct impressions at any one of the little areas.

Just as the camera lens spreads an image of the scene in front of the camera over the entire film surface, so each of the minute embossed lenses portrays on the very small area of sensitive emulsion it covers the scene immediately in front of it—which is the camera lens as seen from that particular point on the film. This means that the sensitive emulsion behind each tiny lens will receive not an image of the whole scene in front of the camera, but only a small bit of the scene, since any point on the film receives rays from only a corresponding space on the scene in front of the camera.

Since the tiny cylindrical lenses

have their axes parallel to the stripes of color on the filter, then the three filter colors covering the lens will be portrayed behind each tiny lens as three parallel vertical stripes. Thus the width of each of the minute areas of emulsion covered by one of the tiny cylindrical lenses will be divided into three parts related to the three colors of the filter and affected by the light that is able to pass through the filter colors. The sum of these small affected areas constitutes the whole photographic image.

A red ray from an object in front of the camera, for instance, touches the sensitive material of the film at a spot related to the red area of the filter. By means of the reversal process used in the development of these "home movies" the negative is made the positive for use in the projector. The spot affected by the red ray will then become a transparent area on the positive, leaving opaque the adjoining areas related to the green and blue segments of the color filter. Therefore, in this case, the projector light can shine only through the small points on the film which will send beams to the red portion of the projector filter, and so out to the screen as pencils of red light.

The same thing occurs with blue and green light and with combinations of colors. But with combinations of colors, we may have either two or all three of the little divisions under each cylindrical lens affected. For example, with yellow light, which is a combination of red and green light, we will have those two areas under each embossed lens affected that are related to the red and green areas of the filter. The sum of the points on the scene containing red makes a photograph from red light on the emulsion areas related to the red filter area, the sum of the blue makes its separate photograph, and so also with the green.

Now in the projector we have the same optical system in reverse order. We have a source of white light, then the developed picture, then the small lenses, then the projector lens, then the projector color filter which is similar to that used in the camera, and finally the screen. Now when we project, light will shine through only those portions of the film that have been affected in the photographing, and so we will send to the screen a beam of colored light, either red, green, or blue, which will be in the proper position on the screen to combine with any other beams to form a reproduction of the color of the original object. For example, consider a spot on the film that was affected by red light on the original object. This spot will then be transparent on the positive. White light from the projector lamp will pass through this spot, through the little embossed lens on the film over that spot, through the projector lens, and come to the projector color filter. But because of the relation existing between the spot on the film and the color filter, this white light will come to the red area of the filter. This will allow only the red portion of the light to pass through, and so a red beam of light will be thrown on the screen. Similarly, light passing through spots on the film related to the green portion of the filter will pass only through the green portion of the filter, and so only green light will be thrown on the screen from that portion of the film. And the same will happen with the blue. Thus for any point on the scene, the only colors which are permitted to be projected are those which, on the screen, blend into the corresponding colors of the scene photographed. The pattern of these rays from all the cylindrical lenses on each frame projects a picture on the screen, with each ray contributing its speck of light to the color or blend of colors at any one point.

The film itself is not colored. The colors of the subject are reproduced

merely by the transparency or the varying degrees of opacity of the film which permit light to shine through one or more of the three areas of the filter as directed by the tiny film lenses. It is even possible by removing the projector filter to obtain on the screen a black and white projection of the subject, and by replacing the filter, again obtain the colored image.

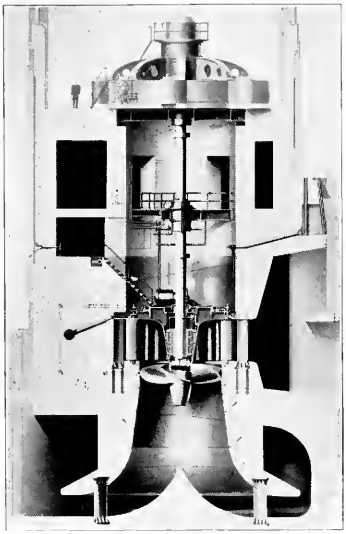
This process is used at present only in the production of colored "home movies," as the reversal process of development is used, and so only one positive is obtained. It is possible to reproduce from this other positives for use in black and white projection, but there is at present no commercial way of obtaining a multitude of positives for color projection, although we can shortly expect the Eastman Company to offer us some solution of this problem.

HYDRAULIC TURBINES

(*Continued from page 54*)

built into the dam and water is conducted to the turbine through passages molded in the concrete. In such cases the spiral casing is omitted.

The foregoing constitute a few of the main features of Francis turbines which occupy the head range down to 40 feet, below which head the third type of turbine is used. In this type there are two main requirements; first, that the turbine handle very large slow



Cross section of the Louisville turbines. Each of these machines develops 13,500 horsepower at 37 feet head.

moving streams of water and second that it run fast enough. Until a few years ago this field was taken care of very imperfectly by Francis runners, but about 1917 Mr. Forrest Nagler developed the propeller type runner, often called the Nagler runner. These runners operate at much higher speeds than the highest speed Francis type and have made it possible to develop heads as low as 7 feet.

In the type of installation the water, of course, flows through the runner in the direction of the shaft and in so doing cause the wheel to revolve. The wheel turns very rapidly, the blades traveling faster than the water in the same way that an ice boat can travel faster than the wind which drives it.

In an accompanying photograph is shown a typical installation as used in the new plant of the Louisville Hydro-Electric Company on the Ohio River at Louisville, Kentucky. There are eight units in this station each developing 13,500 horse power at 37 feet head. The river rises so high during flood times that to avoid any possibility of the generators becoming flooded they are set on an unusually high elevation. The main shaft is so long that it is necessary to use an intermediate steady bearing between the turbine and generator. The interior of the turbine pit is, of course, normally dry and this high setting of the generator is an added precaution.

Open flume machines are small low

head turbines developing a few hundred horse power and operating on heads up to 30 feet. In such cases the power house is in the form of a three-story box. In the top compartment is placed the generator, its shaft extending through the floor to the turbine below. The turbine compartment is a box with the upstream wall left out. The river flows into the box through this open side. A round hole is provided in the floor over which hole the turbine is set and the water flows through the turbine to the lowest story of the structure. This lowest compartment is also a box with its down-stream wall left out. The water flows through the turbine and into this lower box or draft tube chamber and thence out into the tail race.

The three types of turbines just described, namely, the impulse wheel, Francis turbine, and propeller turbine, are the ones commonly used at present although other types of runners have been developed in times past.

American manufacturers and designers are by far the leaders in this industry and for many years American machines have held the records both for size and performance. The world's record for the most powerful turbine has increased steadily from 10,000 horsepower for the Shawinigan turbines about twenty years go to 70,000 for the present Niagara Falls machines. It is interesting to note that these record breaking machines are built in response to demands from the power companies and not from promotion on the part of the manufacturers.

Some of the problems encountered by the designer of these large machines are sufficiently unique to deserve mention. The machine itself is, of course, larger than anything that has been built before, and extremely high efficiency and general performance is demanded. The project is attracting attention throughout the industry and a failure would affect the manufacturer's future business for years. Under such conditions it would be a great advantage to the manufacturer to be able to build the machine and try it before displaying it publicly, but unfortunately it is not practical to give a turbine a shop test on account of the large quantity of water required. Furthermore, the main frame work of the turbine is built into the concrete substructure of the powerhouse and after once being in place cannot be changed. It is impractical to build full size machines for experimental purposes and any experiments on trial designs must be confined to small scale models. The result is that the designer has to produce the machine in one trial.

After it is decided what type of machine is to be built an entirely new set of problems appear, namely, how to manufacture such a large affair with the available facilities. Main shafts such as the 35-inch diameter shafts at Niagara and Conowingo tax the capacities of the steel ingot manufacturers to the utmost. It is not practical to undertake much large shafts until larger ingots can be obtained. The castings, although very large, are as a rule not limited by the furnace capacity of the foundries. Their size is usually limited by transportation clearances. Railroad clearances are so thoroughly established by the standard gage of track that they are not likely to be increased much and as machines increase in size they must be divided into more pieces. The Conowingo runners, for example, were made in three sections, a most difficult problem. Finally the designers must keep the machine within the capacities of the shop tools.

These are a few of the engineering problems which arise and help to make water-power development, as was stated at the beginning of this article, one of the most fascinating lines of engineering today.

The ARMOUR ENGINEER

VOL. XX. MARCH, 1929 NO. 3

Published Quarterly by the College of Engineering
Armour Institute of Technology
Chicago, Ill.

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800,000 pounds of STEAM per hour from one unit!

N. Y. Times, Dec. 1928

NEW YORK EDISON BUYS 3 RECORD-SIZE BOILERS

Will Drive Largest Single-Unit Generating Machine in World at East 14th St. Plant.

Matthew S. Sloan, president of the New York Edison and associated companies, announced yesterday the closing of a contract with the International Combustion Engineering Company for three boilers that will be the largest ever built. Each will be about as high as an average eight-story building. They are to be installed in the East River generating station of the New York Edison Company at Fourteenth Street and will supply steam to drive the largest single-shaft, single-unit electric generating machine in the world, a 150,000 kilowatt turbo-generator now being built by the General Electric Company.

* * *

The over-all height of the new boilers, which are of the Double Ladd type with fin tube water walls, will be 95 feet, with furnaces 23 feet wide and extending back 65 feet. Each will supply a maximum of 800,000 pounds of steam an hour at a temperature of 700 degrees Fahrenheit, at 425 pounds a square inch pressure. The heighth of the boilers is approximately that of an eight-story building, allowing twelve feet for each floor.

With a heating surface of 60,000 square feet each, the compactness of the battery of boilers will make them not only the greatest producers of steam in the world but also the most economical for the space occupied and the coal consumed. Each of the boilers will require 80,000 pounds of coal an hour, or nearly 1,000 tons daily, if operated continuously at that rate.

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COMBUSTION ENGINEERING

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Volume XX March, 1929 No. 3

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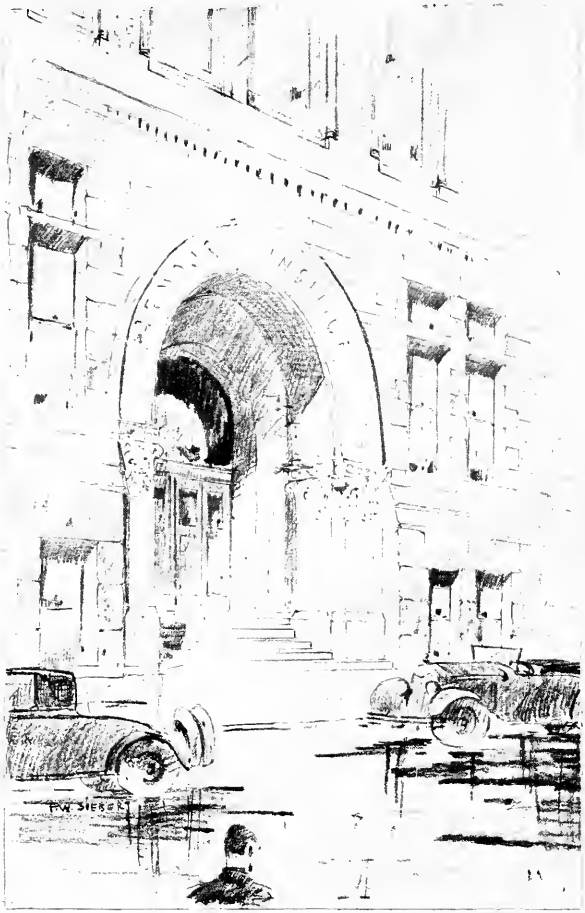
Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.



Entrance to Main Building

The
ARMOUR ENGINEER

VOLUME XX MARCH, 1929 NUMBER 3

The Chicago River Straightening

By M. B. Golber, '29
Student in the Department of Mechanical Engineering

WHEN the Chicago River is straightened between Polk and Eighteenth Streets, a new chapter will have been written in the history of one of the most important rivers in the United States. Comparatively unimportant as rivers go, nevertheless, the Chicago River has had much to do with shaping not only the destiny of the City of Chicago, but much of the destiny of the Prairie States.

However, progress in the land lying immediately south of the Chicago Loop district has been impeded by irregularities in the course of the river. The first effort to remove these irregularities was the shifting of the mouth of the river, which formerly opened a quarter of a mile south of its present location. The first agitation for the straightening of the Chicago river was started in 1805, took twenty-five years, and was completed at a cost of but $25,000. Chicago's newest project was first planned in 1909, work started in 1928, and will cost approximately five million dollars.

Just south of Van Buren Street (the south boundary of the Loop, Chicago's chief business district) the Chicago River takes a decided bend to the east, and an increasingly easterly bend at Roosevelt Road, so that at a point between Roosevelt Road and Sixteenth street, the east bank of the river is within 150 feet of Clark Street. (See the second figure for details of the location of these streets.)

This bend in the river has always blocked the southerly extension of La Salle Street, Wells Street, Franklin Street, and Market Street. The result has been that the southerly expansion of the central business district has been arrested, both because of the location of the river and because of the character of the railroad development in the area referred to. The south side of Chicago has been left with only two streets (Wabash Avenue and State Street) into the business district. Michigan Avenue, the boulevard leading into the business district, is restricted to the use of passenger cars, and Clark Street is too narrow and hilly for extensive use by commercial vehicles.

Construction photo showing typical dredging operations.

Dearborn Street has also been blocked from southerly expansion, not by the bend in the river but by the railroad development adjacent to the river. Practically all the territory lying between Polk Street and Sixteenth Street, and between State Street and the river is occupied by railroad freight and passenger terminals. These terminals have not been laid out so as to best utilize the ground, but have been gradually built up as the growth of the traffic demanded. The straightening of the river will take the channel 700 feet further from Clark Street than it is now, and will relieve the railroads of the necessity of squeezing their tracks into the narrow space existing between the present channel of the river and Clark Street. The additional space thus obtained will enable the railroads to construct new freight and passenger terminals which will be more suitable to their needs than their present holdings.

The opening up of Dearborn Street and of the other streets lying west of Clark Street through this area now occupied by railroads will give the great south side communities three times as much space for streets for unrestricted vehicle transportation (passenger cars, trucks, delivery wagons, etc.) into the business district as they now have. Property values will be greatly increased not only for that land lying immediately about the river channel where it is to be straightened, but in many other parts of Chicago. Intra-urban trade between the south, north,

and west sides of Chicago will be greatly aided by the new arteries opened for commercial vehicles.

This proposition to straighten the south branch of the Chicago River from some point south of Van Buren Street has been under consideration for a number of years. The opening of the blocked streets will be a long step forward in the realization of one of the main objectives of the great Plan of Chicago—"a plan which provides a basis of street circulation and which will weld and unify the three detached sides of Chicago"—the North, the West, and the South. This plan of Chicago, submitted in 1908 and prepared by Daniel H. Burnham and E. H. Bennett, under the auspices of the Commercial Club, showed in a number of sketches the south branch of the Chicago River straightened so that La Salle Street and Wells Street could be extended southward from the central business district.

This plan met with such approval that, at the request of the City council, the Mayor appointed a permanent body to be known as the Chicago Plan Commission to guide the development of the City according to the great principles laid down in Burnham's Plan of Chicago. The first actual progress in the carrying out of the project of river-straightening was the passage by the City Council on July 8, 1926, of the necessary ordinance authorizing the straightening of the South Branch of the Chicago River between Polk and Eighteenth Streets. Since then work has progressed so rapidly that the project may be finished by about some time in 1930.

However, for a number of years after the adoption of the Plan of Chicago and the organization of the Plan Commission in 1909, no appreciable progress was made toward a start in the straightening of the river. One of the greatest reasons for this period of apparent inactivity was the character of development in the areas affected. Practically all the land adjacent to the old channel and lying where the new channel was to run was owned and occupied by railroads. To them the river-straightening meant only the burden and expense necessitated by the alteration of their facilities to conform with the shifting of a large tract of land from the west bank of the river to the new east bank.

It was not until 1913 that an opportunity came to the City whereby an active participation of the railroads could be secured for the purpose of the straightening of the river. In that year the Union Station Company applied for an ordinance to authorize the construction of a new Union Station and other needed facilities in the area west of the river and lying between Roosevelt Road and Washington Street. This ordinance involved the Pennsylvania, Burlington, Alton, and the Chicago, Milwaukee & St. Paul railroads.

The application for this ordinance came to the attention of the Plan Commission and to others interested in the development of the City along the lines outlined in the Plan of Chicago, and they therefore brought the matter of river-straightening to the attention of the City Council Committee on Railway Terminals, the body considering the passage of the ordinance. The Committee secured expert technical advice on the matter, and as a result the Union Station and Pennsylvania Freight Terminal Ordinances passed early in 1914 contained a provision for the straightening of the South Branch of the Chicago River.

Aerial view showing how the bend in the river and the present character of railroad occupation is retarding the southerly expansion of the loop district and the extension of loop streets.

These ordinances established the lines of the new channel for the river, and provided that whenever the City was prepared to proceed with the straightening of the river, the railroads involved in the ordinance would cooperate with the City, and with the other railroads affected in the project, to accomplish the improvement. A further provision was made that the railroads would submit to a board of arbitration the matter of damages arising in connection with the work of river-straightening. These ordinances also secured for the City a number of other improvements which were also in accordance with the principles of the Plan of Chicago. Among these were:

The widening of viaducts between Canal Street and the river to the full width of the street at uniform grade.

The opening up of Monroe Street between Canal Street and the river.

The widening of Canal Street, and the establishment of a more uniform grade thereon.

A double-decked connection between Canal Street and the North Side.

The ultimate opening of Congress Street to the width set forth in the Plan of Chicago.

As a result of these activities it was realized that only a start had been made in the solution of the railroad problem affecting the river-straightening. The City Council Committee on Railway Terminals therefore recommended to the City Council the creation of a special Railway Terminal Commission. This Commission was appointed in 1914 to act in an advisory capacity to the Committee, and in 1915 it submitted a report on the terminal situation in Chicago. Included in this report were tentative plans showing how the property east of the proposed channel for the river could be utilized by the public and the railroads.

All opportunities were seized upon by the Commission to prepare the way for action on the straightening of the river. When the Baltimore & Ohio Terminal Company applied for an ordinance granting it additional rights over certain city streets, the ordinance granted contained a river-straightening provision similar to that in the Union Station Ordinance. Again, when the Chicago & Western Indiana Railroad requested rights over the city's streets, their ordinance also provided for cooperation by the railroad in the matter of the river-straightening. Efforts were constantly directed toward the securing of active cooperation of the railroads affected in the river straightening—either by providing for a satisfactory adjustment of property lines after the straightening or by the development of a cooperative design of a terminal in the area affected.

As a result of a suggestion of the Commission, the Baltimore & Ohio Chicago Terminal Railway Company, the Chicago, Rock Island & Pacific Railroad Company, and the New

York Central Lines agreed to appoint a board of engineers to make a study and a report on the possibilities of the joint use by the railroads of the property that would lie east of the straightened river. Also, the Chicago & North Western Railway Company agreed not to oppose the river-straightening provided that the company received proper consideration of its rights.

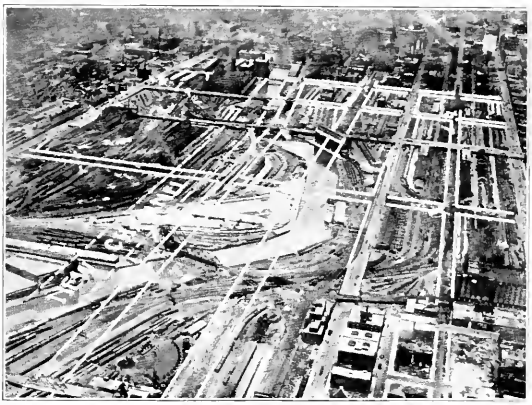
As a result of a number of legal questions involved in the matter of the river straightening which were suggested by the Commission and investigated by the Committee, the City secured the needed state legislation that would aid in the project.

One of the questions involved in all the plans for the straightening of the river was the matter of future terminal facilities for the railroads lying in the affected area between State Street and the river. This development was closely connected with the plans of the Illinois Central for a new passenger terminal on the Lake Front. This terminal could be built sufficiently large to accommodate the passenger traffic of the railroads using the Grand Central, the LaSalle Street, and the Polk Street Stations (the stations affected by the river-straightening). The possible removal to a Lake Front terminal of some or all of the railroads using the stations south of the Loop would have a great influence on the extent to which the terminal facilities east of the river would have to be changed after the straightening. This situation further offered the opportunity of electrifying the entire terminal area along the Lake Front. The War Department also desired that provision should be made for the creation of a harbor district within the area to be improved by the Illinois Central.

As a result of studies on these matters, the Illinois Central Lake Front Ordinance was formulated and all acceptances made by the parties involved in the early part of 1920. This ordinance gave the South Park Commission the right to build a great park along the Lake Front from Grant Park to Fifty-first Street, while the Illinois Central agreed to the construction of viaducts and subways across its property to the new park. The Illinois Central also agreed to electrify its suburban traffic, and its through passenger and freight service within certain periods. The railroad still further agreed to build a new passenger terminal on Roosevelt Road at Grant Park with the provision that the railroad company would allow the use of this terminal, under suitable terms, by any of the railroads then using the Grand Central, the LaSalle Street, or the Polk Street stations.

The passage of the Union Station Ordinance and the Illinois Central Lake Front Ordinance thus left as a major terminal problem only that of the railroads south of the Loop district, which depended so much upon the straightening of the river.

It was impossible during the period of the war and governmental control of the railroads to arouse any interest in river-straightening on the part of the railroad managements, while immediately after the relinquishment of governmental control there were so many other problems requiring immediate attention that little was done in regard to the river-straightening.



Aerial view looking northwest showing how the channel will be straightened and new streets cut through.

In order to again arouse interest in the project, the Terminal Commission in 1921 submitted a report dealing with the various matters involved in the straightening of the river. As an interest-creator the report was successful. Representatives of the railroads met with the Commission, and in a short time certain of the railroads undertook the study of tentative plans for the treatment of the area east of the river.

Shortly after Mayor William E. Dever took office, he called together the executives of the railroads affected, for the purpose of seeing what could be done toward hastening the working out of the plans of the railroads with reference to terminal development and river straightening. At a subsequent meeting, the railroads agreed to the appointment of a committee of executives. This committee appointed an engineering committee which proceeded to work out plans for a development of the railroad facilities south of the Loop.

In the course of these studies, it became apparent that the actual work of straightening the river need not wait upon a final decision on the character of the railroad development to be undertaken. However, it seemed necessary that a reallocation of the lands lying adjacent to the river be made before going ahead with the work. The location of the holdings made impossible an early agreement according to any plans initiated by railroad representatives, and therefore a committee of disinterested prominent citizens of Chicago was appointed. This committee found that any plan of river-straightening would have to contain the following provisions: (a) a determination of an accepted estimate of cost of the physical features involved in river-straightening; (b) the valuation of the property involved in the river-straightening, including the valuation of the reclaimed land and the increase in the value of the lands transferred from the west to the east side of the river; and (c) the allocation of ownership of lands after river-straightening, including land reclaimed from the abandoned channel.

In order to secure an accepted estimate of cost, a series of meetings were held by Edward J. Noonan, Consulting Engineer of the City Council Committee on Railway Terminals; Hugh E. Young, of the Chicago Plan Commission, and representatives of the railroad companies. At these conferences the elements of cost were outlined and studied under the following heads:

1. Construction of new channel and fill of old channel.
2. Railroad bridges over river.
3. Rearrangement of railroad facilities.
4. Sewers, waterpipes, etc.
5. Buildings and miscellaneous facilities.
6. Changes in grade at Sixteenth Street and Stewart Avenue.

In order that the demands of navigation be met and also that a continuous flow in the river be maintained for sanitary purposes, it was decided that the new channel be excavated before the old channel was filled in. Thought was given to the matter of wasting at least a part of the excava-

(*Continued on page* 110)

From News To Newspaper

By J. M. Flynn
Public Survey Department,
The Chicago Tribune

NEWS happens but a newspaper is manufactured. An event becomes news when someone who knows about it tells it to people who don't. The newspaper, which carries more news to more people than any other medium, is as definitely a manufactured product as an automobile or a piano. It is made of paper and contains news, editorials, special articles, illustrations and advertisements. Ink and machinery imprint its contents on its white surface.

Most people, naturally enough, have a fair knowledge of the principal activities connected with news gathering. They know of reporters, special correspondents, editors of special features, and foreign correspondents. They have a pretty good idea of how these functionaries work: their presence at events which make news; their varied methods of keeping their papers supplied with news of what is happening: by cable, telegraph, telephone, radio, aeroplane, courier, mail, and so on.

Few people, however, have anything like an adequate conception of the tremendous mechanical activity expended daily on the job of turning out a newspaper. The reason for this is that the great majority of newspaper readers have never seen a newspaper plant at work. The job is to turn out unfailingly, day after day a product that is entirely new each day it is produced inclusive of Sundays.

We say *new* product advisedly for, excepting the form, there's nothing so unlike as yesterday's newspaper compared with today's. Each day brings its cargo of new news and new advertisements. Even the want advertising section which always looks the same is never the same. Today's hundreds of advertisements are replaced with new hundreds tomorrow, as these, in their turn, will be replaced the day following.

The unique and special problem of a newspaper's mechanical department is to correctly turn out a mighty job involving a multitude of highly specialized operations in an extremely limited space of time. Manufacturers of other products allow themselves a sufficiency of time in which to do a production job. It isn't so with those who manufacture a daily newspaper. Time does its own allotting on this job and does it grudgingly, doling out minutes as if they were days. Whatever else a newspaper must or must not be it must be absolutely on time; on time in getting its news; on time in getting its daily collection of news and advertisements to its readers.

How then is so stupendous an

Scene in the bustling news room.

achievement accomplished with the necessary speed and smoothness? Let's pay an imaginary visit to the plant of the Chicago Tribune and find out. We'll start in the composing room because here begins the first of the newspaper's principal mechanical activities. Incidentally one realizes while in this composing room how merely technical and traditional the word "room" has become. In a great modern newspaper such as the Chicago Tribune the floor space of the "room" covers half a city block. One can best understand how it is organized to meet its great responsibility by taking note of the manner in which it is laid out. The great principle is to have everything come in at the *sides*, flow together in the center, and be discharged down one channel toward the presses, without overlapping or backtrapping to cause confusion and delay. The course followed by the news illustrates this principle. Near the middle of the composing room is the "copy desk." Here is where the news enters, coming as typewritten copy by a basket elevator from the editorial department on the floor above.

From the desk the stories are distributed among the "news-side" linotype machines, then pass the scrutiny of the proof room, and the type, when correct, is placed on the news banks, near the center of the room, ready to be placed in the pages when the paper is made up. Advertisements travel a similar route from their receiving desks to the make-up forms. Thus everything is brought to a focus at the make-up forms; and the "way out" for each page as it is made up, is to the steam tables, where a matrix is taken from it and sent down on a chute to a molding machine in the basement, where a stereotype is made. Thus the controlling principle is observed in every detail—even to the manner in which the Sunday edition material is segregated in one corner where it cannot interfere with the operations of the daily paper.

After the rush of getting out the current morning paper, all the made-up pages are kept, just as the stereotypers finished with them, standing in a row—an orderly memento of the previous evening's tremendous effort. About the time the first men of the day shift arrive, the auditing department sends a marked copy of the paper. This copy bears a notation for each advertisement appearing—whether it is to be held for use again, or "killed." With these sheets before them, two men go over the forms from which the previous evening's paper was prepared, and remove all news and advertisements that are "dead," throwing the metal into a wheeled bin to be melted down for further use.

Ads that are to appear on a later day are placed in galleys duly tagged. Those that are to appear next day remain in the forms, as a start on the make up for the day. This operation

for the classified section of 40 to 200 columns is a matter of some time and requires great care.

Not all of the metal used in display advertisements goes back at once to the melting pot. Many cuts and name plates are preserved for future use. The accumulation, consisting of many thousands, is kept in a steel cabinet of more than 500 pigeon holes, each pigeon hole being allotted to one advertiser and labeled with his name. With the help of a catalogue these cuts may be found when wanted, saving the cost of remaking.

Advertising

Meanwhile the other members of the day force are preparing for the great daytime tussle—that of getting the new display advertising ready for next morning's paper. While the preparation of news right before deadline seems more dramatic, the "ad side" of the composing room has its trials as well. For one thing, the "ad room" must work with a great variety of types and sizes as compared with the straight-away composition of the news. Again, in handling news, the paper has the "say so," and, in time of need, can make adjustments. But with advertising the client has the "say so." He is entitled to say, (within ethical limits, of course), whatever he likes in his advertisement, to have the type just the way he wants it, and so on—and the "ad" men must give him what he wants, so long as his wishes are made known by late afternoon of the day preceding issue.

A monotype casting machine. This casts the metal in individual characters. The linotype machine casts the entire line.

Troubles, of course, do not arise with every ad. For the most part the advertiser outlines in detail what is desired, and the compositors need only follow the directions. Much of the pressure comes from advertisers whose copy must be "timely." Department stores, for example, adjust their offerings for a day according to many factors, among them the weather, and must wait until the last minute before they are sure what they want; and often a double-page department store advertisement will be returned at the last minute so cut to pieces as to necessitate almost entire resetting.

But one way or another, each advertisement is made ready and a proof is taken. This goes to the proof readers and comes back with corrections noted. Often many proofs are taken before the advertisement is finally approved. When finally approved the name, form and size in agate lines of each advertisement are entered in the display ad schedule. The advertisement in type then goes to the make-up bank, where it lies ready to be placed in a page form at the proper time.

The small "want" advertisements are set by operators on the linotype machines. Each operator carries his completed "take" to the "bank" and places it, without regard to classification, in one of the galleys set apart for that purpose. Proofs are then taken and when corrected, the type in galleys goes to the tables near the make-up line. Here they are assorted according to the classification. The make-up tables are arranged in long lines just as when the news pages are made up later in the evening; and as the advertisements in type are classified, they are made up in pages, as we see them daily, having special regard to their arrangement according to size and classification.

With his display and want-ad schedules in hand, the foreman of the composing room then proceeds to make up the paper from an advertising standpoint. He makes a dummy for each page, showing the precise location, size and shape of every display advertisement on the schedule, and his men place the advertisements in the page forms. At 7:30 these dummies go to the night editor, and with them as a basis he makes up the news. By 8 o'clock the last form of want advertising is locked and turned over to the stereotypers, clearing the way for the first edition.

Beginning somewhat after 5 o'clock, news matter comes down to the composing room in various conditions and in varying volume. It has, however,

The automatic switchboard which controls the giant presses. It is housed in a sound-proof glass enclosed balcony above the press room.

one invariable quality. It is typewritten.

In the argot of the local room (the local room is where the news is received and edited) each news item, whether an inch or a column, editorial or market report, is a "story," and all stories are classified under general headings such as "F" for Financial, or "Wash" for Washington. Within each class the stories are numbered, the first one to arrive getting the number 1, and so on. Meanwhile long metal trays called "galleys," have been set out in readiness to receive the type when set, and each galley bears one of these classification numbers. For example:

22 WASH 22

marks the galley which is to receive the 22nd item of Washington news.

Assigning these numbers and getting all this copy under way is the task of a man called the "copy-cutter," who might be called the train dispatcher of the composing room. When a batch of copy comes down in the basket from the editorial department, it is carried by the copy boy to the copy box on the copy cutter's desk. If the item is short, the copy cutter simply marks upon it its proper classification and number.

If it is a long story he classifies it, notes the "guide line" or "slug"—usually a single word, such as "Hewitt" or "Primary" by which the editorial department knows it—and enters it in the schedule. Then he removes the headline copy and cuts the body of the story into sections of convenient lengths, called "takes." These are each marked by name and galley numbers. The sections, or takes, are also given

serial numbers, subordinate to the general classification numbers, for convenience in reassembling the copy and the type after it has been set.

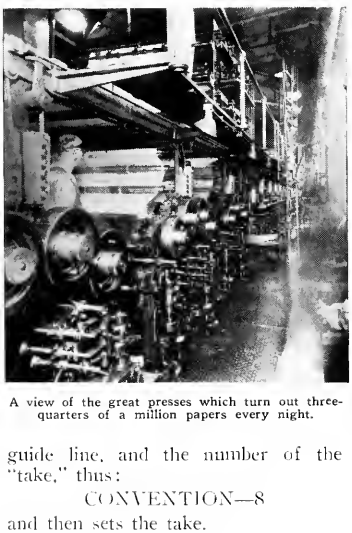
The Trickiest Part

The trickiest part comes when a story comes along in sections, far apart, as often happens with stories covering emergencies, political conventions and the like. When the first section comes in, it receives its identifying marks and the "takes" are numbered. Then the copy cutter must keep on the alert for the symbol which will bring order out of the seeming chaos caused by the sections of the story coming at various times.

Meanwhile the compositors are turning the various "takes" into type. A compositor does not pick his take; he takes the one at the top of the hook. Once back at his machine he places a stereotyped slug, bearing his number, thus:

29 TWENTY-NINE 29

at the head of his "stick" for type. This identifies the type which follows as set by him, and aids in computing his pay. Then he sets the editorial



A view of the great presses which turn out three-quarters of a million papers every night.

guide line, and the number of the "take," thus:

CONVENTION—8

and then sets the take.

When a galley is full or a story complete, the bank man carries the galley and its copy to the proof press. Here the machine-driven rollers are running rapidly over the stone. The boy deftly puts the galley in place and with great skill takes off ten proofs, which he hangs on convenient hooks. Four of these are for the editors in the local room, four are for certain New York correspondents and news syndicates, one goes to the "dupe-hook" for use in making up the pay sheet, and one, with its copy, to the proof readers.

In the proof room an assembler folds each proof in its own copy and lays it in a stack at his left. Here the proof readers come to get it, always taking that which lies on top. There is no picking and choosing.

A stuffing machine which takes the various sections and folds them together.

Reading proof is an exacting occupation. The reader must not only see to it that the proof "follows copy," but he must correct any transgression of the rules of composition, or any other manifest errors even though they agree with the copy.

The proof, corrected, goes to the "correction bank," where it is laid upon its own galley of type. The man who set it corrects it. As many proofs as are necessary are pulled until the galley is found correct.

Thus it goes throughout the evening until "deadline," near midnight, when the home edition is made up. By reflecting on the process it can readily be seen how flexible it is, and how admirably suited to a newspaper's needs.

When pressure is light, as in the early evening, "takes" may be longer and each compositor comes nearer to handling complete stories. If a big story comes at the last minute, the "takes" may be made short and ten, or even a score of compositors may work on it. In either case the procedure is the same; so there is never any occasion to do anything "special," and the news flows automatically, without fuss or frenzy, to the makeup banks, no matter what the pressure.

While all this has been going on, the editorial department has been shaping its plans for displaying its product to the best advantage, and shortly before midnight several of its representatives arrive to superintend the placing of the news stories in the page forms. Here is where the full beauty of a newspaper's organization becomes apparent. As these men arrive there awaits them a long row of wheeled tables, each bearing a "chase," or metal frame, for one page, with the advertising allotted to that page already in place. Across the form is the makeup man who places the type where the editorial representatives direct. Half a dozen reporters may have worked on a story, perhaps as recently as fifteen minutes earlier. A dozen compositors and several proofreaders, to say nothing of others, may have contributed their efforts; but thanks to the system there is the story complete, ready to be placed instantly on whatever page the editors direct.

Several of the pages are made up earlier in the day—pages bearing market news, for instance, that are practically finished early in the evening, and pages bearing feature material only. But the rest are all made up within fifteen or twenty minutes; and as rapidly as they are finished, the page forms are wheeled away to the stereotypers. Stereotyping, briefly, consists of the following steps: First, a matrix, or mat, is made by forcing a sort of moist blotting paper upon and into every crevice of the type page under great pressure and then baking it. Second, this paper fac-simile is bent into the form of a semi-cylinder and its inside surface, bearing the impression of the type, is used as a mold for a metallic stereotype, also known as a cast. A few minutes in the stereotype room and the paper is practically ready for the press, within less than half an hour from the time the last news came in.

The Press Room

While newspaper men differ as to what is most thrilling in their business, all agree that there is a fascination to a modern press in operation. There it sits, a structure as big and complicated as the old-style engines of a battleship driving their vessel at top speed to combat. Attached to it are huge rolls of paper that seem to shrink of their own volition, as though melting in some mysterious way. At several places a huge flood of papers literally pours out—hundreds of them as you watch, enough to load a news stand while you address a short remark to a friend. Yet, aside from the roar of machinery, there is no bustle, no confusion of any sort. It is almost ghostly to see that giant mechanism, one unit of which is as large as many a family's cottage, whirring smoothly beneath the beating electric lights, with a dozen or more pressmen hovering anxiously about and peering into its spinning interior as it contentedly disgorges the news of the day for hundreds of thousands of waiting readers.

What is the secret of this quiet, yet marvelously efficient process? More than all else, it is due to the use of

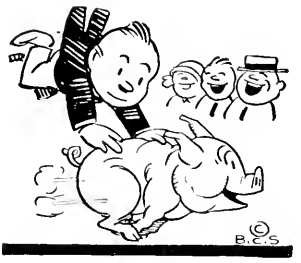
(*Continued on page* 112)

Engineering and Progress in the Packing Industry

By C. L. Lohner, '28

WHEN the layman to the engineering profession thinks of the packing industry, he invariably sums up the entire business as consisting of the slaughtering of livestock, preparation of the carcasses for the market and the manufacture of edible and inedible by-products. He wonders in what capacity the engineering profession might be associated with the packing industry. Some years ago, this connection consisted only of supplying steam and refrigeration to the packing plant, but in the last decade or so the engineer's work has become more and more closely interwoven with the actual processes of product preparation. At one time only the carcasses of animals were valuable as meat suitable for sale to the public, the remainder being classed as offal which was buried in underground pits as a means of disposal. Handling of carcasses during the processing stages was inefficient with the result that much spoilage occurred due to bacterial action, this ensuing in a higher cost of preparation.

However, owing to competition among packers, the latter found it necessary to adopt more systematic methods of processing and to reduce losses due to wasteful and inefficient methods of handling product. There arose a need for the application of a careful and intelligent analysis of each phase of the industry. The engineer, because of his scientific training in analyzing situations and his ability to apply constructive reasoning toward improvement in general, seemed best adapted for this work. Today, through the application of engineering methods, the handling of carcasses has been greatly improved, thereby hastening operations and reducing waste due to spoilage by bacterial action. Much work which was formerly done by hand is now done by machinery to permit of increased output and reduced unit cost. By research in chemical engineering, etc., what was once classed as offal is now almost entirely manufactured into edible and inedible by-products. The former class consists mainly of fancy meats, sausage casings, gelatin, rennin (which is used in cheese-making), lard, butterine, cooking oils, etc. The inedible class includes soap, soap powders, glue, fertilizer, etc. The effect of competition on creating an effort to sell at low net profit may be seen from fact that today carcasses of beef, etc., sell for less than the



price at which the live animal is bought, this discrepancy, in addition to cost of processing and profit, being regained from the sale of by-products manufactured from what was formerly offal or waste.

Efforts to still further simplify and improve methods and equipment are progressing constantly through exhaustive testing by joint co-operation of technical engineers with experienced packinghouse men.

In the engineering field proper, continual improvement is going on. Refrigeration in the packing industry is needed for the preservation of meat by preventing or decreasing bacterial action. In all parts of the living animal body, internal and external, there are innumerable germs or bacteria. While the animal lives, there exist in the blood stream what are known as white corpuscles or leucocytes which form a resistance to and prevent the entrance of bacteria into the blood stream. However, directly after slaughtering, the white corpuscles are no longer effective with the result that bacteria enter into bloodstream and decay begins at once, although it is not apparent to the human senses until some time thereafter. The temperature of an animal body when alive is about 100 deg. Fahr. and it rises slightly after slaughtering, reaching about 105 deg. Fahr. At these high temperatures bacteria thrive very rapidly, their rapid growth causing the state of decay. This process can only be prevented or delayed by lowering the temperature of the carcass as quickly as possible.

Lowering the animal temperature is known as "chilling" and is normally carried on in coolers above which are lofts in which the refrigeration system is located, there being openings or ducts along the walls which connect the loft with the cooler. The refrigeration system used may be brine spray, sheet brine, or direct expansion ammonia, with brine for defrosting. By means of any of these systems, the carcasses are chilled by circulation of air. The heat from the carcasses warms the air about them, there then being a tendency for this heated air to rise. In seeking the highest possible level, the warm air passes through the ducts or openings in the ceiling at one side of the cooler into the loft above, where it is guided by walls or baffles so as to be cooled by contact with brine spray or ammonia coils, as the case may be. The air, now being cooled, seeks the lowest level attainable. Before leaving the loft, the cold air is forced against and under a heavy canvas curtain which hangs almost to the floor of the loft. This is done to prevent the air from carrying brine spray to the cooler below by reason of its high velocity. The cold air then passes through ducts in the loft floor to the cooler below, entering the cooler on the side opposite to that from which the warm air leaves the cooler. The cold air then replaces the warm air which has been drawn from about the warm carcasses and in turn becomes warmed by contact with the carcasses. This completes the cycle of circulation which is repeated end-

(*Continued on page* 118)

String-Lining High Speed Railroad Curves

By F. B. Farrell, '29
Student in the Department of Civil Engineering

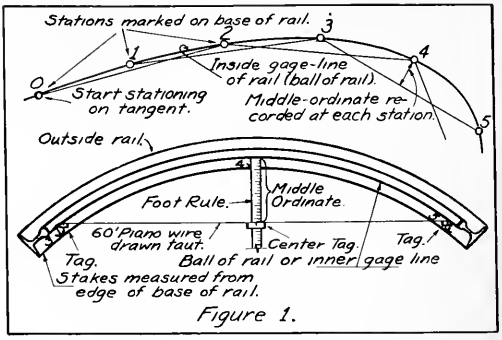


Figure 1.

COMFORT is one of the most essential requisites of modern transportation. The effort to maintain pleasant traveling facilities is evinced by the courtesy of employees, mechanical comfort, etc., of the railroad service. Smooth riding curves are one of the most desirable characteristics for riding ease at high speed.

There are several methods of obtaining a smooth-riding high-speed curve. One that has been recently introduced in the Chicago Terminal Division of the Pennsylvania Railroad is the so-called method of "string-lining." This means of producing easy riding curves has been used more or less extensively in the eastern sections, and was first brought into practice in the Chicago area by Mr. E. O. Wood, Division Engineer of the Chicago Terminal Division of the Pennsylvania Railroad.

The time required for the adjustment of a curve so as to produce an easy riding one is much less by this method than in the case of setting stakes by a transit, and is capable of a higher degree of accuracy as well, being applicable to both compound and spiraled curves. It can be used only when the track is already laid and is close to line, the purpose of the string-lining being to take the small kinks out of the curve that prove so objectionable when a train hits the curve at high speed.

This method consists essentially of a system of lap chords laid off on the inside of the rail in which the middle ordinate of each chord is recorded. The necessary instruments consist of a foot-rule and a piano wire 60 feet long which is accurately marked by means of tags at both ends and at the center. The stationing is started along the tangent and is continued on the inner side of the concave rail. Station marks are made on the base of the rail by means of yellow keel to protect them from being worn off until stakes are set.

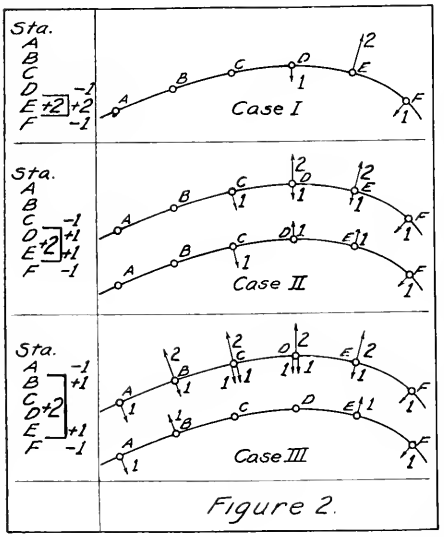


Figure 2.

Station number 0 is chosen and conveniently marked on the tangent. The rear man holds the end mark of the piano wire flush on the ball, or gage line, of the rail at this station. The front man draws the wire taut and also holds his end flush against the ball of the rail. The note-taker then measures the middle ordinate (See Figure 1) to the nearest ⅛-inch at the middle marker on the wire by means of the foot-rule held against the ball of the rail, and at the same time marks the station number on the base of the rail. The wire is then moved until the rear man is at the station just marked, the front man is two stations ahead, and the note-taker is at the intermediate station where he again measures the middle ordinate and marks the station. By using a 60-foot wire, thus making 60-foot chords, the stationing will be every 30 feet. A check on the original transit work is also available because the middle ordinate of a two degree curve with a chord length of 60 feet is 1⅞ inches.

The theory underlying this method will now be discussed. We shall first consider the effect on the track if one station is moved 2 units outward as indicated in Case I, Figure 2. This movement must necessarily be compensated in the track structure by an equal and opposite movement along the track. For 60-foot chords, the following explanation seems to be very well borne out in actual practice. It is assumed that if station E is moved outward 2 units, this is compensated by the inward motion of the two adjoining stations, D and F, of one unit each; thus making the total inward and outward motion of the track equal to each other, causing a zero change in length of track. This is recorded, as indicated to the left of the diagram. The portion on the inside of the bracket indicates the "throw" or the outward motion of station E alone, whereas the numbers on the outside of the bracket indicate the "effect" on E and the adjoining stations. This shows that D goes in (—) 1 unit, E goes out (+) 2 units, and F goes in (—) 1 unit.

The effect on the track when two adjacent stations are moved outward is given in Case II. When station D is moved outward 2 units, the adjoining stations, C and E, move in one unit each. The same is true of station E which will be the same as in Case I. Here we have a total outward movement of 4 units, and a total inward movement of 4 units, making the change equal to zero. The upper diagram of Case II shows the "throws" and their "effects," while the lower diagram gives the combined effect of the total movement, which is obtained by adding the vector quantities in the upper diagram. This is recorded as

shown to the left of the diagram. The number on the inside of the bracket indicates the "throw" of the stations that are included in the bracket, while the numbers on the outside indicate the "effect" upon the stations involved.

Case III illustrates the condition wherein three or more adjacent stations are thrown outward. This is merely an application of the two foregoing examples and is evident by inspection. It is represented as shown to the left of the diagram.

The throws were all taken outward for convenience of discussion, the above analysis applying equally well to negative or inward "throws," in which case all of the signs would be changed.

An actual set of notes with their solution is given on this page in order to illustrate their application. The stationing is indicated in the left-hand column, and the middle ordinates as measured in the field by string-lining is given in the next column. An ordinary foot-rule is used, and in order to facilitate the calculations, the middle ordinates are recorded directly in the field as multiples of one-eighth of an inch. Thus a 1 in this column indicates a middle ordinate of ⅛-inch, and a figure 19 would indicate 19 8-inch or 2⅜ inches. This is done because of the ease of handling whole numbers.

High-speed curves, such as used on the tracks of the Broadway Limited are invariably spiraled. This means that the middle ordinates, starting on the tangent, must gradually increase until a uniform value is reached. The throw that each station will receive is determined by the "effect" that is desired in combination with the adjoining stations. This is accomplished by starting at the top of the set of notes, gradually working down and taking out all of the kinks and irregularities. The "effect" column is completed by adding the "effect" of a throw (the numbers on the outside of the bracket) to the value in the "ordinate" column.

The numbers in the "effect" column will require frequent adjustment during a calculation and should be written in light pencil and erased until a good looking progression of ordinates is obtained. This is the progression of ordinates that would be obtained if the indicated throws were made and the curve string-lined once more. Thus in the column adjoining the "effect" column the throws are added for each station. These quantities are added across from the numbers included in the brackets. At station 70, for instance, when we go horizontally across, three brackets are intercepted, and the throws included are added up, giving a total of $+2+2+2=+6$. At station 71, only two brackets are intercepted, giving a throw of $+2+8=+10$. In the next column these values are divided by 8 to change to inches.

THE PENNSYLVANIA RAILROAD — String-Line #1 Main, Calehour, Indiana — K A Worden, P Carroll, 9/5/28

Sta.	Ord	String-Line #1 Main, Calehour, Indiana	Effect	Throw ⅛	Throw	Stake
44	0		0	0	0	12
45	1		1	0	0	12
46	2		2	0	0	12
47	4		4	0	0	12
48	5	+2	7	0	0	12
49	13	-4 [-2	11	-4	-½	12½
50	17	-2 +1 +½	16½	-4	-½	12½
51	16	+2 -2 [-1 +½ -½	17	-3	-⅜	12⅜
52	19	-1 -1] -1	17	-4	-½	12½
53	16	+1 +½ -½	17	-1	-⅛	12⅛
54	17	-½ +½	17	0	0	12
55	17	-1 [+½	16½	+1	+⅛	11⅞
56	15	+2 [+1 +1 +½	16½	+3	+⅜	11⅞
57	16	+1 -½	16½	+2	+¼	11¾
58	18	-1 -1	16	0	0	12
59	15	+1 +2 [+1	17	+2	+¼	11¾
60	16	+1 -1 +1	17	0	0	12
61	20	-2 [-2 -2] -1	17	-4	-½	12½
62	17	+1 -1	17	-2	-¼	12¼
63	16	+1	17	0	0	12
64	16	+1	17	0	0	12
65	17	+½	16½	-2	-¼	12¼
66	18	-2 [-1 -1] -1	16	-3	-⅜	12⅜
67	16	+1 +½ -1	16½	0	0	12
68	16	-1 +1	16	+2	+¼	11¾
69	16	+2 [+1 -1	16	+4	+½	11½
70	17	+1 +2 +2 +2 -4	16	+6	+¾	11¼
71	12	-1 +1 +1 -1 +8 +4	16	+10	+1¼	10¾
72	14	-1 -1 +½ +4	16½	+6	+¾	11¼
73	21	-2 -½ -4	16½	-3	-⅜	12⅜
74	16	-1 -1 +1	16	-3	-⅜	12⅜
75	18	+1 -½ -2] -2	16½	-3	-⅜	12⅜
76	12	-1 -1 ½ +1	11½	0	0	12
77	7	+1 -2 +2 +2	8	+4	+½	11½
78	9	+4 +2 -1	5	+6	+¾	11⅛
79	1	+2 +2	3	+6	+¾	11¼
80	2	+1 -2	1	+2	+¼	11¾
81	1	-1	0	0	0	12

A typical set of field notes.

When string-line stakes are set, they are placed so that when the track is "in line" they will be 12 inches from the base of the rail. If there is a throw of 0-inch indicated in the next to the last column, then the stake is placed 12 inches from the base of the rail and the track foreman does not touch this portion of the track. If there is a throw of $-\frac{1}{2}$-inch, this means that the track has to be moved inward ½-inch, so the stake is consequently placed $12\frac{1}{2}$ inches from the base of the rail.

When a station comes directly over a tie, the stake is placed midway between this tie and the adjoining one, a longitudinal variation of a foot or so being a negligible quantity in the adjustment of the track. The stake should be chosen of such a length as to be firmly imbedded in the ballast, and not move each time a train passes. They are best placed on a level with the base of the rail (top of the tie) so that the required throw may be easily measured by the foreman. A track gang will probably have to line several times before all of the stakes will be exactly 12 inches from the base of the rail.

When there is frequent traffic over a track to be string-lined, it is necessary that the least possible amount of time be lost between the string-line operation and the setting of the stakes, since the track may move with the passage of a train and put the notes in error. In this case, the following field operations afford a convenient method of expediting the work. The curve is first taped off in 30-foot lengths. The curve is then string-lined, it being possible to tabulate the data very quickly when the stations are already marked. Then while the note-taker is calculating the necessary "throws," the assistants will drive stakes 12 inches from the base of the rail. All that remains is to "tack" the stakes and the curve is finished. The head of a stake is usually large enough to permit of placing the tack well in the top, since the variation of the track throw is seldom more than ½-inch on either side of the 12-inch mark.

String-lining proves its worth by being a speedy and efficient means of checking curves. The degree of precision available is much higher than in the case of a corresponding amount of transit work. The transit requires an accurately calculated set of notes in order to set stakes every thirty feet, and is subject to errors in the instrument work or the taping. The transit method becomes more or less complicated and tedious when setting stakes for a spiraled or compound curve, and in such instances the lap chords are a decided advantage.

As previously stated, it is desirable that a curve be string-lined during a lag in traffic, so that the passage of heavy trains will not alter the position of the stakes and thus affect the data. Track shifting under traffic is especially noticeable if the track has recently been laid or reballasted and graded.

Ballistic Engineering

By H. E. Stier, '30
Student in the Department of Electrical Engineering

Measuring the chronograph rod.

Ballistics is the science or the art of hurling missiles by an engine. It is an old science, missile hurling being practiced by early man. His engine, at first, was his arm and then some form of bow with which he was able to get a higher velocity with a given weight of projectile.

Today ballistic engineering has become a highly specialized science, involving problems in chemistry, mechanics, and electricity.

Guns, the engines for hurling projectiles, are of different types and purposes, designed for some particular use for which they give the best results. The barrels are smooth or have rifled bores. The diameter is usually given in fractions of an inch or in inches. In Europe the bore diameter is always given in the metric system. The smooth bore is a hollow tube, smooth on the inside, but sometimes tapering toward the muzzle, to the frustum of a cone, as in a shotgun, for the purpose of concentrating the shot. Rifled barrels contain grooves, located spirally in the bore and cut in the barrel by special rifling machines. The projectile takes these lands and grooves and in its passage down the barrel is given a rotating motion. This rotation gives the missile its stability after it has left the barrel and keeps it flying point onward.

Most every one is familiar with some type of sporting or target rifle and thus it is better to bring out some of their problems and actions.

In the barrel and in direct center of the axis at one end is located the chamber for holding the charge, a projectile, and primer. In small arms these are contained in a brass shell known, when assembled, as a cartridge.

Back of the chamber is some form of breeching mechanism designed to hold against the rearward thrust of the brass shell when it is fired. As action and reaction are opposite, it is necessary to have the breeching strong enough to hold the pressure developed in the gun. For instance, in some bolt actions guns, such as the Springfield, locking lugs engage when the bolt is closed and hold against the pressure.

A gun is an internal combustion engine and subject to all of the problems encountered in such an engine. The projectile in the gun is the piston. The propellant is a powder of such chemical composition as to burn rapidly when ignited, and to generate a gas; the gas occupying many times the volume of the original powder. This gas forces the projectile ahead of it and imparts to it a velocity. Some powders are progressive burning, that is, as the projectile travels along the barrel the powder continues burning which gives additional gas and pressure. The rapid combustion of powder gives rise to high pressures and accompanying high temperatures. Common working pressures are in the neighborhood of 40,000 to 60,000 pounds per square inch and temperatures of about 3,000 deg. C. Pressures in revolvers are not as high as given above and are of the order of 15,000 pounds per square inch.

The method of taking pressures is known as the Radial Pressure system. A figure showing the gun set up for firing is given with also a cut-away figure showing the various parts in place. A heavy barrel is used with a housing built about the breech end. A hole is located one inch from the breech and is drilled at right angles at an axis of the bore. The hole is bushed and drilled to a diameter of about 0.2250 inches. A piston is made to fit this hole, say 0.2250 inches and equal to the length of the piston hole. The piston is then lapped to give a perfect fit with no sticking or misalignment.

The piston is inserted when a test is to be made, with a lead crusher cylinder placed on the piston. The lead cylinder is held in place by a screw and anvil attachment built into the housing. The gun is then fired, the pressure acts equally in all directions and thus forces the piston against the lead cylinder, crushing it. The length of the lead cylinder is less after firing and the difference in its length gives the pressure applied. The exact pressure is then read from a table for each variation in length of the lead cylinder. The table is known as a Tarage table.

The powder is fired by means of a primer on which a blow has been applied. The blow explodes the composition of the primer and sets fire to the powder. The primer consists essentially of potassium chlorate, antimony sulphide, lead sulphide and trinitrotoluol. These are the compounds used by the United States government. This priming compound causes considerable rust because the potassium chlorate upon giving up its oxygen leaves potassium chloride, a salt much like table salt and with an affinity for water as great. In the last two years noncorrosive priming compounds have been developed, one of which consists of mercury fulminate, lead picrate, antimony sulphide and barium nitrate impregnated with one per cent of diphenylamine. It is to be expected that there is still room for research and advancement in primers as well as other phases of interior ballistics.

The steels commonly used in ordnance construction are practically the same as the steels found on the commercial market. There are certain

properties which are really a necessity in ordnance work besides the commercial requirements. The steel must be as light a weight as possible for a desired strength. This is especially true for the mobility of guns. The most wanted property of a steel is that it should resist the high temperatures of the powder gases which cause considerable erosion. Rapid erosion soon wears the rifling and the interior of the bore so that the gun becomes inaccurate and thus of little value.

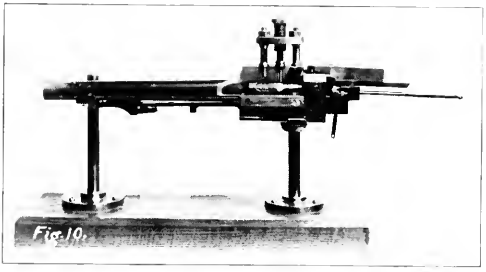
The mountings of large guns require strong bases which are usually made of steel except in the case of shoulder arms. In shoulder arms wood is used for the stock. The wood most commonly used is walnut, although it is not the only variety that may be used. All bases or stands for guns are subject to shock, that is, the load applied to the base by firing is impressed upon it in a very short interval of time. It is, therefore, necessary in the designing of mountings to have them capable of carrying the shock of the guns which it supports. This applies to all types of mountings whether of steel or wood and like all designs it is necessary to take in many considerations, both theoretical and practical.

The study of ballistics involves research and experimental work. This is especially true of exterior ballistics. At the instant that the projectile leaves the barrel the influence of the atmosphere and gravity begin to act. Gravity attracts the projectile toward the ground and the amount of fall is dependent only upon the time of flight which in turn is dependent upon the velocity.

Exterior ballistics then deals with the time of flight of the projectile. The velocity, the energy, the angle of departure and such influences as the interior ballistics may induce. The energy is the same as is used for all kinetic energy of K. E.=½MV². The angle of departure is that angle which the axis of the projectile makes, at the instant of firing, with the line of sight. The range of the gun is also important in military work and its importance may be cited by the German "Big Bertha" used during the recent World War. The following account taken from "Ordnance and Gunnery" by McFarland tells just what the gun was.

"The gun is commonly known as the Long-Range Gun, the Big Bertha, and the Seventy-five Mile Gun. The terms of the Peace Treaty specified that one of these guns, in perfect condition, should be turned over to the Allied Forces. This term of the treaty was never complied with and all of the seven guns constructed appear to have been destroyed before they could be viewed by any of the Allied observers. The information and data available have been collected from various sources.

The secret of the long range attained is attributed mainly to two conditions.



Section of pressure gun. All parts are in position for firing.

(a) The guns were built to withstand a maximum pressure of 67,000 pounds per square inch (nearly twice the normal pressure for which our own guns are designed), which gave to the projectile a muzzle velocity of at least 5,250 feet per second.

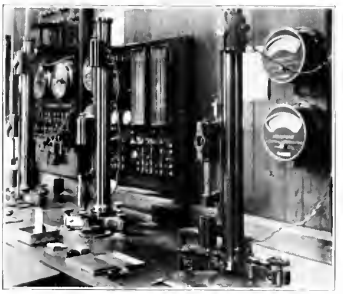
(b) With this very high velocity, the projectile gained such a height that 50 miles of the trajectory, for the 75 mile range, lay in air of a density approximating one-tenth that of the earth's surface.

The guns were fired from positions at Laon, Ham and Fere-en-Tardenois. Approximately 300 rounds were fired, 180 falling inside the walls of the city and 120 outside the walls. The life of the guns was probably not over 60 rounds.

The "Big Bertha" was not a profitable investment for the Germans, but it presented a gun of very original design and disclosed a marked advance in ballistic research.

The determination of the velocity of a projectile is made experimentally, although close approximations can be made if certain quantities are known.

Wire at muzzle of gun. This completes one circuit of the chronograph.



Closeup of the chronographs. The chronograph in the foreground has the rods in position.

The instrument usually employed for determining the time of flight of a projectile over a given range and from which the velocity is calculated is known as the Le Boulengé modified by Bréger. It has been somewhat changed as seen and used in the United States. It is designed to measure the time elapsing between the breaking of two electrical circuits. The two circuits are composed of wire screens placed in the path of the projectile and at a known distance apart. The projectile breaks the wire of the first screen, allowing a magnet to release a rod on which a mark has previously been made. Another mark is made when the projectile has pierced the second screen. The distance the rod has fallen in the time required for the projectile to pass between the two screens is measured by measuring the distance between the two marks with a pair of vernier calipers—from the law of falling bodies the time may be calculated. The mean velocity can be calculated knowing the distance between the screens and the time, by dividing the distance by the time.

The chronograph must be kept level and free of jars and vibrations. It is essentially a laboratory instrument and requires carefully adjusted electrical conductors for satisfactory operation.

With favorable conditions the Boulenge chronograph will measure short intervals of time with a mean error of 0.0001 second, which is about ¼ of one per cent in determining the muzzle velocity.

Other types of chronographs have been designed and are used where more portability is desired.

Ballistic engineering, a branch of applied mechanics, like other branches of engineering and scientific research is interesting and well adopted to the engineer interested in the subject and willing to gather more information.

Factor Tests of an Internal Combustion Engine

By Daniel Roesch, '04

Associate Professor of Automotive Engineering

THE power developed by an internal combustion engine is dependent upon the number of B.t.u. in the charge which is taken into the cylinder. The temperature and pressure of the charge in the cylinder and the volumetric efficiency (by card) are factors which determine the B.t.u. in the charge. These factors are not readily determined although the volumetric efficiency by the card can be quite accurately obtained for low speed engines. Since engines are tested at various laboratory temperatures and pressures it is essential to convert all test data to some standard of temperature and pressure and know the characteristic effects of variation in the observed temperature and pressure upon the power developed.

Pressure Correction Factor

Pressure observations made during engine tests are usually the barometer readings. If the intake manifold depression and the intake valve pressure-drop are subtracted from the barometer reading the results will be in accord with the actual pressure of the charge in the cylinder. The apparent correction formula would then be:

$$\text{I.H.P. (Std.)} = \frac{\text{I.H.P. (Actual)} \times 29.92 - (\text{M.D.} + \text{V.P.D.})}{\text{Bar. (Test)} - (\text{M.D.} + \text{V.P.D.})} \quad (1)$$

where 29.92 = standard barometer (In. Hg.); MD = manifold depression (In. Hg.); V.P.D. = valve pressure drop (In. Hg.).

The accepted formula used in engine tests is

$$\text{I.H.P. Std.} = \frac{\text{I.H.P. Actual} \times 29.92}{\text{Barometer (Test)}} \quad (2)$$

The difference in results when operating at wide open throttle and moderate speeds corresponds to values of (M.D. + V.P.D.) equaling about 1 or 2 inches of mercury. For low altitudes and engines operating at wide open throttle there is little practical difference but for high altitude testing and for corrections made at part throttle or with high-velocity intake systems the added factor in the correction formula may be desirable. This condition also prevails when operating at high engine speeds. Taking into consideration that any effects produced by a particular engine design should not be included in the correction factor, then the modified formula would only seem applicable for high altitude test corrections and include a general arbitrary constant subtracted from the barometric readings.

The correction factors by formula (1) and (2) when computed for a 1.5 inch Hg. total pressure drop with (a) 28.5 inches barometer, (b) 24.5 inches and (c) 18.0 inches barometer will be as follows:

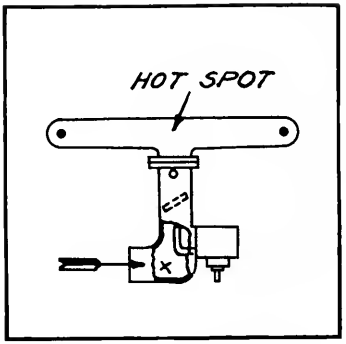


Diagram of the thermocouple positions.

Barometer In.Hg.	Approximate Altitude, Ft.	Correction (1)	Factors (2)	Variation percent
28.5	1500	1.052	1.050	0.6
24.5	5500	1.234	1.221	1.1
18.0	13000	1.723	1.663	3.8

The variation in the results obtained by the two formulas is usually too small to warrant the additional complication except for special cases. Moreover, high altitude tests are usually reported per se.

The use of this characteristic formula for B.H.P. corrections involves an approximately constant "friction" power subtracted from each of the I.H.P. values and introduces a slight difference in the power ratios. For most test work, however, the same form is used. The pumping loss of the "friction" power has only a slight change with barometer and the mechanical friction does not change materially except for large power changes. Moreover, the mechanical efficiencies are usually quite high and when determined provide data for computing the necessary changes in the formula.

Temperature Correction Factor

The temperature correction factor is often subject to modifying influences which are greater in number and magnitude than those surrounding the pressure correction.

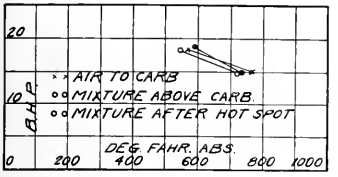
The choice of the point in the induction system at which the temperature is observed may be:

(a) Room temperature
(b) Hot air entrance to carburetor
(c) Carbureted air at outlet of carburetor
(d) Intake manifold after hot spot.
(e) Cylinder mixture temperature at end of suction stroke
(f) Cylinder mixture temperature at the point where the compression line crosses the atmospheric pressure line.

The temperature at point (f) is undoubtedly the most reliable for ascertaining the B. t. u. in the charge and the power correction formula characteristic. It has the objection that engine and manifold design characteristics are included and is very difficult to determine accurately. Obviously an engine which must be operated very hot for satisfactory fuel vaporization and distribution (as with kerosene) should not be credited with the resulting large power correction which its high temperature would give by the formula. The temperature at point (e) has similar conditions surrounding its use.

The temperature at (a) does not include satisfactorily the engine and fuel requirements. There is usually a hot air stove provided to furnish the desired temperature of air entering the carburetor. This temperature (b) is often recorded in tests. If it has been adjusted to the minimum required for satisfactory engine operation (vaporization and distribution), then it would hardly seem fair to credit the engine

with an increased power resulting from using this temperature in a power correction formula since the fuel consumption would undoubtedly be greater with colder air. The temperature (c) at the outlet of the carburetor is difficult to determine experimentally due to the wet bulb effects and the fact that an appreciable time is required for evaporation. Exploration of the region just above the carburetor jet also indicates by variable wet bulb temperatures the expected stratified mixture. The time element required for vaporization was approximated by noting at what distance above the expanded gasoline jet the wet bulb effect seemed to disappear. Knowing the size of the pipe and the volume of room air corrected for temperature at this point, this time was computed for one condition of test as about 0.005 seconds. It was necessary to use a spacer between the carburetor flange and the manifold flange to permit observations without having undue radiation from the hot spot which was located directly above in the manifold. Undoubtedly this point is not practical for reference temperatures since the wet bulb and radiation effects in commercial installation make them uncertain. In most commercial installations the wet bulb effects are present in the manifold branches and subject to the influence of hot spots.



Typical test showing B.H.P. vs. temperature.

The point (d) represents conditioned mixture before passing through the inlet valve. This latter action furnishes some heating effects from the valve and some from the walls and the residual gases in the cylinder, although in special cases of extremely hot air and large expansion ratios or low explosion pressures at light loads, there have been indications of a cooling effect upon the mixture as it enters the cylinder. This point at which temperatures may be observed is significant as being the last point in the flow at which reliable data can readily be obtained experimentally.

Observations have been made of the entering air temperature (b) the carbureted air above the outlet of the carburetor (c) and the mixture in the intake manifold just before it enters the cylinder block (d). These are indicated in the accompanying chart.

Two series of runs were made upon a 149 cu. in. four cylinder engine operating at 1000 r. p. m. and wide open throttle. Test No. 1 was made at 5.7 to 1 volume ratio and Test No. 2 was made at 4.6 to 1 volume ratio.

The fuel was not especially adapted to the particular compressions or high temperatures and the spark advance was not adjusted for best power but was fixed in each case. For optimum power the spark advance should be adjusted with changing temperatures and the detonation requirements should be taken care of by using fuels suitable for the particular compression and also for the high temperatures used in some of the tests.

The crosses show observations of intake air. The circles show mixture above the carburetor and the solid dots show intake manifold temperatures. A straight line drawn through the points is taken as a representative power correction line for temperature. The value of the exponent n in the characteristic theoretical equation

$$\text{B. H. P. Std.} = \text{B. H. P. Actual} \left(\frac{\text{T (Actual) Abs.}}{\text{T (Std.) Abs.}} \right)^{n}$$

is commonly taken as 0.5.

If the value of n is computed from the experimental data as shown, neglecting the lack of curvature to actually follow the formula, the values are as follows: based on the extremes of the observed temperatures.

It will be noted that all values of "n" increase as the stations become closer to the cylinder. The figures show a maximum value of nearly unity in Test No. 1 based on B.H.P. and conditions just before entering the inlet valve. This value is not substantiated by Test No. 2, but the trend is in the same direction. For a critical examination along these lines for absolute values, the spark advance and anti-knock qualities of the fuel should meet the temperature requirements of the mixture. The mixture ratio is also a factor modifying the results, since it has a direct bearing on the anti-knock value of the mixture and the power developed.

TEST No. 1

			Exponent "n" B.H.P.	I.H.P.
Station No. 1 (Crosses)		(Air to Carb.)	0.741	0.629
Station No. 3 (Circles)		(Mix. above Carb.)	0.761	0.645
Station No. 10 (Dots)		(Mix. after Hot Spot)	0.995	0.776

TEST No. 2

Station No. 4 (Crosses)		(Air to Carb.)	0.587	0.499
Station No. 7 (Circles)		(Mix. above Carb.)	0.621	0.562
Station No. 8, 10 (Dots)		(Mix. after Hot Spot—Average of 2 branch pipes)	0.776	0.658

In order to agree with the characteristic theoretical formula exactly there should be a slight dip in the curve. Some of the observed values indicate this trend. Further deductions are difficult because of the lack of information on the heat transfer behavior under the variable velocity flow through the system and the uncertainty of the vaporization time necessary for complete removal of wet bulb temperature effects. The difference between the computed values by this method and the straight line function as drawn is only 0.2 B. H. P. at the mid-temperature position of the air to carburetor (crosses) in Test No. 1. The line shows 16.75 B. H. P. at 209 degrees Fahr. while the computed value is 16.55 H. P.

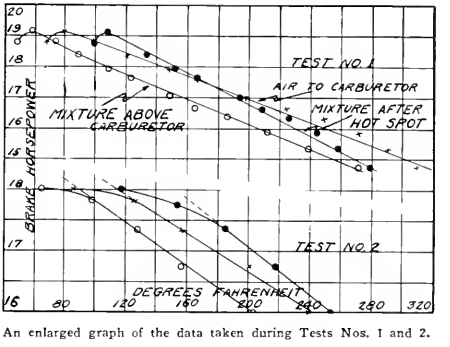
The straight line characteristic is represented by the general formula:

$$\text{Power Ratio} = 1 + \frac{t}{k} \qquad (3)$$

The test data give the following values of k.

TEST No. 1

			Value of "k" B.H.P.	I.H.P.
Station No. 1 (Crosses)		(Air to Carb.)	807	940
Station No. 3 (Circles)		(Mix. above Carb.)	738	860
Station No. 10 (Dots)		(Mix. after Spot)	593	690



An enlarged graph of the data taken during Tests Nos. 1 and 2.

TEST No. 2

Station No. 4 (Crosses)		(Air to Carb.)	1025	1163
Station No. 7 (Circles)		(Mix. above Carb.)	921	1045
Station No. 8 10 (Dots)		(Mix. after Hot Spot—Average of 2 branch pipes)	808	918

The data is subject to modification when the optimum spark advance is used at the various temperatures and also when the mixture ratio is fixed at the various tests. In these tests a fixed spark was used at too late a position for best power. The carburetor

(*Continued on page* 116)

ENGINEERING NEWS

The Cascade Tunnel

Another great engineering feat, an eight-mile tunnel, now the longest in America, has just been completed by the Great Northern Railway. This tunnel, which pierces the backbone of the Cascade range, is but a part of a great $25,000,000 improvement through the Cascades, while electrification of nearly twelve miles of tunnels and snow sheds make up the remainder of the program.

The tunnel was first considered in 1916, but was dropped because of the war until 1921; in 1925 construction was finally decided upon. It is 7.79 miles long, is straight from end to end, and has a grade of 1.56 per cent descending from east to west. Its cost was $14,000,000, more than half of the $25,000,000 improvement program.

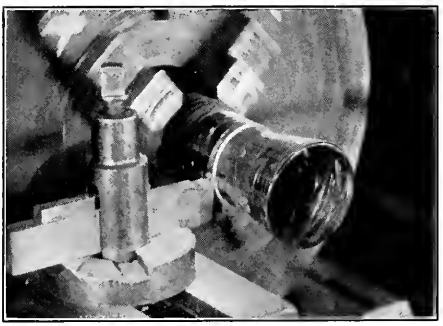
As the railroad wished to use the tunnel as soon as possible, it was necessary to get as many working faces as possible. From Mill Creek, located directly above the projected tunnel, a shaft 622 feet deep was sunk. This gave two faces in addition to the end faces on which work could be started. A pioneer tunnel of eight by nine feet section and located fifty feet south of the main tunnel was first driven east and west from the Mill Creek shaft. Every 1500 feet along this tunnel, cross tunnels intersecting the main tunnel were constructed. In this way as many as eleven working faces were in operation at one time. One of the accomplishments of the construction period was continuous twenty-four hours a day, seven days a week, operation.

It may be of interest to the reader to know that when the pioneer headings met three thousand feet underground and four miles from the west portal, lines carried in from the two ends were only seven inches apart and with a difference in elevation of only nine inches. Such was the engineering accuracy of this tunnel. The excavated rock was used in making embankments, not a cubic yard being wasted.

Completion of this tunnel and thirty-four miles of level high-speed track, replacing forty-three miles of steep, winding mountain line, together with seventy-five miles of electrification will serve to bring the west coast closer to the east.

Carboloy

One of the most recent products of the research laboratory of the General Electric Company is a material which, by combining hardness with strength, is well adapted to the manufacture of cutting tools capable of meeting present day conditions. This new marvel of science, Carboloy, is composed of tungsten carbide and cobalt and is twice as hard as the hardest steel that can be made. An effective cutting tool for lathe work must have strength as well as hardness, and Carboloy, by the addition of the cobalt, has been made over half as strong again as high speed steel.



Cutting glass on a lathe with Carboloy.

This new tool substance has other interesting properties which make it suitable for work on almost any material and under any circumstances.

It does not pit or tarnish, and such temperatures as are encountered in cutting metal at speeds ordinarily used have not been harmful. Bearing surfaces of commutators of electric motors, made of alternate layers of mica and copper, have been a problem because they must be accurately machined. Although mica is very abrasive, the new tool material is found to give a sharp finish. The chilled surface layer of cast iron, especially if it contains sand, takes the edge off the best tool steel; Carboloy penetrates without difficulty. In cutting Bakelite fabric gears used in automobiles, cobalt-chromium tools require redressing after every 150 parts; under identical conditions, Carboloy cutters finish 11,000 parts before sharpening is necessary.

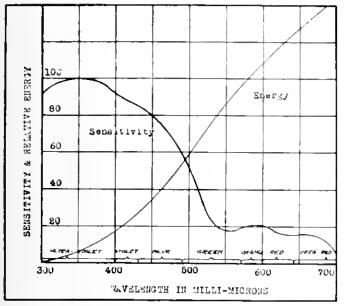
As a rule, cutting tools will not affect a glass rod but instead the edge of the tool may be worn off if pressed against it. The tungsten carbide tool will not only perform, quickly, the simple machining operations on glass, but may also be used for cutting screw threads in a glass rod.

Lighting in the Movies

Two developments, contributing to the movie industry, have resulted in better quality films at a decreased cost. These two developments are the panchromatic film and high capacity, high intensity incandescent lamps. The use of panchromatic film coupled with incandescent lighting has made possible an accurate reproduction of the relative brightness of all the colors. Prior to the panchromatic film it was impossible to reproduce, on the film, the colors in their natural brightness. Colors of the higher wave lengths, red, orange, and yellow, would not appear at all, while colors on the other side of the scale, blue and violet, would appear with a magnified intensity. The pictures obtained were very distorted, and unnatural makeups and color treatments had to be employed. The addition of certain dyes to the emulsion that coats the film, renders the film sensitive to the entire visible spectrum. While this film registers all the colors it is not equally sensitive to each, the violet-blue region being considerably stronger, as Curve A shows. The panchromatic film, therefore, requires a light that abounds in colors in the red-yellow region. The incandescent lamp does just this thing. Curve B shows the abundance of high wavelength colors and the lack of low wavelength colors. In this way the excesses of one compensate for the deficiencies of the other and the net result is a film that shows all the colors with their natural intensity.

By the use of incandescent lamps, illuminating expenses have been halved. Formerly illuminating costs made up

five per cent of the total production expenses. Now they consume only two and a half per cent. Only eight to twelve men are needed to handle the equipment, where thirty or more were needed before. Sets are photographed more quickly and failures are fewer,



Curve showing panchromatic film and incandescent lamp characteristics.

thus eliminating retake costs. Incandescent lamps have an efficiency such that the energy used can be reduced to one-half of its original figure. Either alternating or direct current can be used and expensive motor-generator sets can be eliminated. The lamps used are 115 volt, with a power output ranging from 1 to 10 kilowatts. They are either tubular, globular of pear shape, and they measure from 9 to 20 inches in length.

Diesel Engines for Aircraft

Heretofore, the subject of Diesel aircraft engines has been an idealistic one in which certain practical achievements were visualized as a result of painstaking and exhaustive research. The task of making Diesel engine sufficiently light for aircraft purposes presented such problems of extraordinary difficulty as to make the subject open to much adverse criticism. However, contrary to all the criticism, a Diesel airplane engine has been built and actually tested for several hundred hours. Since this engine is still in the experimental stage, a description of the mechanical details must be omitted.

It is readily recognized that the Diesel aircraft engine must be run at a speed at least five or six times as fast as the stationary engine; since the ignition time lag is substantially the same in both cases, it can be seen that the high speed engine demands a different type of combustion than does the low speed Diesel. It is, therefore, not surprising to learn that it is necessary to use the very high cylinder compression pressure of twelve hundred pounds per square inch. Such a pressure may be thought to militate against a sufficiently light engine construction. This fear is unfounded as is proved by the fact that the Packard Diesel aircraft engine weight only 3 pounds per horsepower and withstands cylinder pressures well in excess of 1,200 pounds per square inch; it has also been subjected to flight testing and to ground testing.

The advantages of Diesel engines for aircraft are as follows:

1. The Diesel engine is inherently far more reliable than the gas engine; (a) the electric ignition system is eliminated and (b) a separate fuel injection is supplied to each cylinder, thus assuring a maximum dependability.

2. The fire hazard is reduced to the absolute minimum.

3. The specific fuel cost is reduced about seventy per cent.

4. Open exhaust ports are permissible from both noise and from night-flying vision viewpoints.

5. Engine protection is not affected by temperature or humidity conditions —flexibility of control is assured at all times.

6. Radio interference is eliminated.

The Deion Circuit Breaker

Electric power circuits are protected against short circuit by automatically operated breakers which open the circuit. The opening is accompanied by an arc, which has an essential part in the operation. If the arc is not quickly extinguished, however, current will continue to flow through the ionized gas and much damage may result.

It is in the quick destruction of the arc and restoration of open circuit conditions that the latest development along these lines has occurred. The Deion circuit breaker has a stack of copper plates one-sixteenth of an inch in thickness spaced this same distance apart. The arc formed as the contacts are separated is transferred to this stack, where it is broken up into a series of short arcs. When the current passes through its zero value the arc is instantly extinguished. If the arc were maintained between the arcing contacts of a breaker in high voltage service, the air would remain ionized and allow the destructive current to flow. The difference in the actions is due to the rapid deionization of the air near the cathodes, which allows a potential of 250 volts to be maintained without the passage of current. The rapidity of the action is due to the fact that the electrons in the vicinity of the cathode are removed by repulsion; the positive ions are discharged into the cathode. The recombination of ions farther from the cathode is much slower. This circuit breaker may be used on lines of higher voltage by increasing the number of plates, hence the number of cathodes, in series.

The transfer of the arc from the opening contacts to the series of plates is accomplished by use of a magnetic field, which "blows" the arc from the arcing contacts to the plates. As an arc discharge is rather concentrated the current was found to be of sufficient heating value to melt the plates. To overcome this difficulty a radial magnetic field was created in the plates. This caused the arc terminal to be driven in a circle thus distributing the heat and preventing destruction of the plate.

Because of the possibility of replacing oil breakers, great interest has been manifested in the Deion type. Rigorous tests have been made and the Deion circuit breaker has successfully met them. Voltages as high as 15,000 and currents as high as 28,000 amperes have been employed and with the perfection of several details, the Deion principle will probably be employed without great difficulty for circuits above 25 kv. potential.

Lighting the Opera Building

The new Chicago Civic Opera Building will be of interest in its demonstration of the latest practice in lighting,

The New Chicago Civic Opera Building.

both interior and exterior. It was found that more beautiful and interesting effects could be obtained by so-called "high lighting" in color than by floodlighting the entire exterior of the building. At the same time the cost would be about one-fifth as great. The plan to be followed is the crea-

(*Continued on page* 120)

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering
ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XX **March, 1929** **No. 3**

O wad some power the giftie gie us
To see oursel's as ithers see us!
It wad frae monie a blunder free us.
—*Burns.*

THE ARMOUR ALUMNUS. Some years ago the alumni section of the Armour Engineer was the official publication of the Alumni Association, but with the establishment of a separate alumni paper, the department in the Engineer became merely an alumni section for the benefit of the student body. At that time it was felt that, although only a relatively small number of the alumni paid their Association dues, yet some contact should be kept with the remaining graduates. A less expensive publication than the Engineer enabled them to reach everyone, and so the change was made. Because of this, the alumni circulation of the Engineer fell off to a very small number, for which we do not greatly blame the alumni.

Early in November of this college year the editorial department approached the Alumni office with the suggestion that the official organ of that office be once again placed solely in the Engineer. It was further suggested that the former objection to the Engineer, i. e., that it reached only some four hundred alumni, could be overcome by reprinting the alumni section, which would be increased to four pages, and sent to all remaining alumni. At that time it was brought out by the Alumni office that plans for the future of the Alumnus were not definite, and it was not certain whether that publication would be continued in the event the position of executive-secretary were not continued, and for this reason the Alumni office welcomed our suggestion. It assured them that their publication would be continued if they wished.

Since the Alumni Association had already entered into a contract for the printing of this year's issues, the change could not be considered for this year, and pending further information on the disposition of the Alumni office, a decision was put off until this spring. Negotiations were resumed a few weeks ago, and the Alumni office invited the "Armour Tech News" also to submit a bid for a similar service for purposes of comparison. We understand that their offer is to devote space to alumni news once each month, and to send that issue to all alumni. For some reason the News has thought fit to represent themselves as the first contenders for this service, and has devoted much space to the matter, without, however, presenting any argument as to why the original plan should be dropped and their publication substituted therein.

The advantages of our plan to the alumni and the Engineer are many. The cost to the alumni will be the actual cost of the service, the increased circulation giving a prestige among engineering college publications that warrants this offer. There doubtless would also be an increased appeal to the advertiser. The expense to the Alumni Association would be less than that of the other plan and less than at present. While it is not our idea to underbid anyone we feel that the low price is necessary in order that the alumni may avail themselves of more than four issues when we change to a monthly.

To the majority of the alumni there would be made available the same service they now receive, and to the supporters of the Alumni Association there is made available a general engineering magazine at the same time. Most alumni probably subscribe to a trade journal which presents articles on one field—few have at hand a magazine presenting general articles on all branches of engineering. About fifty per cent of our

articles will be from outside or alumni sources, so there will be no lack of appeal. The engineering news section, presenting short items on the latest engineering developments, should hold as much interest for the alumnus as the student.

Furthermore, a resume of college events, as presented in our local section, should be of greater appeal to the alumnus than a detailed account of all happenings. The high lights, the things worthy of permanent record, should be of greater interest than the details.

We can see nothing but benefits to both parties from adoption of our proposition. We trust that the matter will be seen in this light, and that we may once again serve our alumni.

ENGINEERING. To select a certain branch of engineering is one of the most difficult problems that confronts any student entering a technical college. Every branch has certain advantages and also a number of disadvantages.

The technical high school is supposed to give the students somewhat of an idea as to the character of the different branches of engineering, and in a simple way help to decide what branch to study at college. But the little elementary knowledge that is taught at the high school is far different from the actual subject as taught at a technical college. In plain words, the high schools often give a false impression.

Dr. H. N. Davis, President of Stevens Polytechnic Institute, in his inaugural address has divided the seven main branches of engineering into the minor groups of each branch. In all, he has found that these seven major units can be subdivided into forty-seven separate kinds of engineering. For a young man to decide which one of these forty-seven branches he shall major in requires the wisdom of an unusually brilliant man.

It is an impossibility for a school to teach all forty-seven different branches of engineering. Modern industry does not expect it, and for that reason has established its own methods. But modern industry does expect the graduate of a technical school to have a reasonable knowledge of physics, mathematics, chemistry, the principles of thermodynamics, and electrodynamics. With the proper understanding of these fundamental principles, the student has the necessary tools for stepping into any branch of industry and, with the helpful methods of the industry, become an active member.

Doctor Davis in his discussion has pointed out that specialization in industry is the only thing today, but that a general knowledge of the basic ideas of engineering should be taught at the technical colleges instead of a certain branch of engineering.

By the time that the college student is ready to graduate, he is more mature in his ideas and he is also able to better determine what branch he believes himself best fitted for. He has not wasted any time in specialization but rather has improved himself because he has a real knowledge of the fundamental principle of engineering. With such a knowledge, he can go into any specialized branch without much additional training. If he does not feel himself fitted for the first enterprise he becomes connected with, he can still choose another without much loss of time through the gaining of specialized knowledge.

To prove his theory, Dr. Davis has given illustrations that no doubt will furnish much food for thought. To illustrate, he quotes the instance of a certain firm which hires many technical graduates each year. This firm will not let a man holding a degree in electrical engineering perform such work, but rather sends him into mechanical or civil work. They justify their action by saying that the student knows electricity because he has studied and specialized in it, but that his true worth as an engineer is to make him think in other terms than electricity; that the knowledge gained from self-perseverance is far better than that gained from a specialized curriculum.

No doubt Dr. Davis' theory will have many believers, and also many who deny its worth, but it must be given credit because it has been created from facts.

SAFETY IN INDUSTRY. Last year there were 95,000 people killed in this country by accidents. Twenty-five thousand were killed in industry and about three million were so seriously injured that they had to be away from work at least one day. In a certain industry 21 men out of every 100 lose some work because of injury and incapability. To the employer it means a loss in profits because extra help is always needed when the men are injured, and compensation must usually be paid to the injured workman; to the employe it means suffering and loss of income.

The Busy Man

If you want to get a favor done
By some obliging friend,
And want a promise, safe and sure,
On which you may depend,
Don't go to him who always has
Much leisure time to plan,
But if you want your favor done,
Just ask the busy man.
The man with leisure never has
A moment he can spare,
He's always "putting off" until
His friends are in despair.
But he whose every waking hour
Is crowded full of work,
Forgets the art of wasting time—
He cannot stop to shirk.
So when you want a favor done
And want it right away,
Go to the man who constantly
Works twenty hours a day,
He'll find a moment sure, somewhere,
That has no other use,
And fix you while the idle man
Is framing an excuse.

—*N. Y. Ledger.*

There are two fundamental factors in accident prevention. The first is engineering, and engineering includes the safeguarding of equipment and workmen. It means the placing of covers and guards over all machinery that is dangerous and the protection of the workman in all possible ways. Good illumination and ventilation are also vital necessities for the efficient production and success of a business, for they promote the good health and comfort of the workman.

Education is the second fundamental factor. Education, from the standpoint of industry, means the education of the workmen to the practice of safety. For every type of work there are two ways of performing it; the first is the easy way, which oftentimes is the dangerous way; the second, is a little more tedious perhaps, but the element of safety plays a big part. To educate or rather instruct the workmen on the fundamental principles of safety is to get them to practice safety rules and to adhere to them at all times.

STAFF. The Managing Board announces at this time the appointments of C. G. Anderson, '30, and N. B. Buehling, '30, to positions of assistant editors; H. H. Stebbins, '30, as assistant business manager; J. A. Ransel, '30, as art editor. Although the number of juniors working on the staff is considerably greater than it has been in past years, there are still several openings for capable men.

ONE GOAL ATTAINED. Adoption a few days ago of a constitution by the staff of the Engineer places the entire supervision of this magazine in the hands of a Managing Board. This Board has both student and faculty representation; it was not deemed advisable to have alumni representation on a committee in direct control of the magazine. Yet the advice of our alumni was felt to be necessary, and a separate committee was formed some months ago. This is entirely an advisory committee, although we expect to increase its membership with the idea of facilitating the collection of alumni news.

It is expected that the Board will give an air of permanence to the magazine, and make less hazardous the transition of staffs from year to year. The Board will not create an unwieldy organization — direct management of editorial and business departments is retained by editor and business manager, and as long as their departments function to the satisfaction of the Board there will be no interference in the carrying out of routine business. The editor and business manager should be the leading figures on the Board; their ideas should be the policies of the magazine as far as possible.

The entire Board will be conversant with the financial status of the magazine. It will determine advertising rates and subscription rates, and will decide on the advisability of certain expenditures. The A. T. A. A. officials will probably continue to scrutinize all accounts, although with adequate faculty supervision all that need be investigated will be the sum total cost to the A. T. A. A. It is, of course, proper that this be done. The financial committee of the A. T. A. A. cannot, however, be an authority on all the factors concerning publication problems. In order that one or two men may not be relied on for such questions, the Managing Board was created. The A. T. A. A. will decide how much the magazine may cost them—the Board with its faculty members will decide on the details of this cost.

THE FIRST PROBLEM. By this time representatives of many national and local companies have interviewed almost the entire senior class. The day after the first delegation had visited the Institute there were serious looks on many faces. The tension of the last few months changed from one of anticipation to one of active concern. The first real problem had presented itself. Not a problem that could be worked out on a slide rule, not a problem that could be solved by formulae—but one that must be solved entirely by the reasoning of a man's mind.

The decision of most men will indicate the degree to which they have been trained to solve such problems. Many will decide by hit or miss methods, on the strength of rumor, or by the action of others. Others will investigate many propositions and will weigh the advantages of each, and will analyze their own likes and dislikes, fitting their decision to suit these—they will demonstrate a scientific-mindedness. This year's opportunities are many. May they all be filled wisely.

COLLEGE NOTES

American Institute of Electrical Engineers

The Society has had the most successful year in the history of the present senior class. The faculty has cooperated by allowing a definite hour for meetings held every two weeks. Classes were excused for these periods and Sophomores as well as the Juniors and Seniors were given the opportunity to attend. This assured well attended meetings which gave every good reason for obtaining good speakers. The fact that the meetings were of a worthwhile nature was shown by the fact that classes in other departments were excused for nearly every meeting of the society and Science Hall was none too large for the accommodation of the audience. Committees were appointed which actually functioned in an efficient and businesslike manner. The result was that the programs were planned weeks in advance, and the smokers were unusually well attended by many alumni as well as students. The society has every reason therefore to be exceedingly proud of its activities this year, and it is.

The following are a few of the speakers and the subjects of their talks:

"The Technical Man in Industry," Mr. F. Schmidt, Western Electric Co.

"The Vitaphone and Movietone," Mr. R. Burns, '24, Marks Bros.

"Electricity in Medicine," Mr. J. Dawson, '29.

"The Neon Tube Sign," Mr. G. Rummel, '29.

"After Gradnation, What?" Mr. T. G. LeClaire, Secy. Chicago Section, A. I. E. E.

"Television," Mr. U. G. Sanabria, Television Engineer.

"Insulated Cable Manufacture," Films by Okanite Co.

"Talking Movie," Mr. O'Roark, Bell Telephone Laboratories.

"Neon Tube Signs," Mr. Lindsay, Federal Electric Co.

Armour Radio Association

The association began its activities on October 9th with the election of the following officers:

President .....F. H. Bigelow
Vice-President .....B. Dudley
Secretary .....R. L. Van Osdol
Treasurer .....W. J. Ehrmeyer
Chief Operator .....H. H. Dozois

Due to lack of time for operating, Van Osdol has since taken the place of Dozois as chief operator. He is rebuilding the transmitter in an effort to make the signals of the station more stable. It is hoped that the new arrangement will improve matters, although it would seem that a great deal of trouble and instability may be traced to the condition of the transmitting antenna. The guy wires have rusted until the mast is in danger of falling unless new cables are installed very soon. Anyone interested in helping to prepare new guys and putting them up should see Van Osdol. Several men will be needed.

The first meeting of the association was held jointly with the A. I. E. E. and the A. S. M. E. The speaker was Mr. U. G. Sanabria who gave a talk on Television. This meeting aroused a great deal of interest in the subject and was attended by a record audience.

A college for parrots has been established at Brownsville, Texas, and has attracted more than 1,500 birds from all over the world who have come to be taught how to talk. A phonograph is used in the instruction. The course of training lasts three months. Each week the parrots are given examinations and graded; and the worth of each is judged by the quantitative flow of words which they are able to emit upon graduation, a method of judgment presumably copied from some colleges.

If You Are Courteous at Heart

If you are courteous at heart
You'll need no book of etiquette.
You may not do the thing that's
"smart";
You'll blunder now and then, and
yet
In any crowd, in any set,
You'll get along well from the start.
Of manners far the greater part
Is courtesy. You needn't fret,
If you are courteous at heart
You'll need no book of etiquette.
And if your words are kind, not tart,
Your deeds considerate, you'll get
Smiles from the shop girl or soubrette
And bows from fortune's pampered
pet.
If you are courteous at heart
You'll need no book of etiquette.
You may not know the finest art
Of greeting people you have met,
But any place upon the chart
From Oskaloosa to Thibet,
At table d'hote or a la carte,
Reception, ball, or luncheonette
With roughneck or Sir Hubert, Bart.
You'll need no book of etiquette
If you are courteous at heart.

—*Berton Braley.*

The Real Washington Portrayed By Pastor

The Rev. A. W. Palmer, of the First Congregational Church of Oak Park, spoke before the entire student body on Feb. 21, "Who Was George Washington?" was the subject of his address. "Recently, there has sprung up a school of literary debunkers, who gain notoriety by digging up mud and slandering the characters of our great men," said the doctor. "These debunkers have had a try at Washington and he has been accused by Rupert Hughes, in a recent speech, of being a card player, a dancer, a curser, and a distiller of whiskey." "While all this may seem to be true," Rev. Palmer continued, "Washington was never known to have become drunk, and his role of whiskey distiller was not in as ill repute as it is today, whiskey distilling being the method used by all farmers to rid themselves of their surplus corn at a profit. He had slaves as did other plantation owners but he never believed in slavery, and his will provided for the release of his slaves.

"Washington belonged to the aristocracy of his time. There is a theory that all great men have grown up in log cabins. This theory does not always hold true, as the case of Washington illustrates, for the true acid test of democracy lies in that there is an equal chance for men of all classes.

"That Washington ranks among the greatest strategists in the world is readily seen by his accomplishments in the face of tremendous obstacles. He was handicapped by a lack of funds, the instability of the continental currency, and the lack of a strong government to back him up.

"As well as being a soldier, George Washington is known as a great statesman—firm, wise, far sighted, and generous. As the first president he was called upon to decide many trivial details that now have become custom. He had to bear more abuse than any president since and under all these trials he bore up with silent courage."

Western Society of Engineers

Officers

President .....Edward Mohr
Vice-President .....Geo. Petters
Treasurer .....Harry Nissen
Recording Secretary .....Theo. Friedman
Corresponding Secretary .....Joseph Boula
Student Representative....Frederick Farrel
Faculty Adviser .....Prof. M. B. Wells

The program committee of the Western Society of Engineers for 1928-29 was very successful in securing for our meetings speakers of wide engineering knowledge, who presented their subjects in a manner of interest to both upper and lower classmen. The scope of the topics covered practically every branch of the civil engineering profession.

Program of the W. S. E. for 1928-29

Oct. 4, 1928

"Re-inforced Concrete Bridges." Mr. Hoyt—Engineer, South Park Commission.

Oct. 18, 1928

"Aesthetic Features in Bridges." Prof. M. B. Wells.

Nov. 1, 1928

"Highways." Mr. M. J. Fleming—District Engineer, Illinois Highway Commission.

Nov. 16, 1928

"General Engineering on the Railroad." Prof. A. L. Stevens.

Dec. 6, 1928

"How Chicago Protects Its Water Supply." Mr. H. H. Gerstein—Sanitary Engineer, Sanitary District.

Dec. 19, 1928

Fall Smoker. Phi Kappa Sigma House.

March 1, 1929

"Daily News Building." Mr. F. E. Brown —Consulting Engineer.

New Books in the Library

The following titles are among the newer books recently received in the Library:

ANGELL, R. C. *The Campus.* A study of contemporary undergraduate life in the American universities.

BOOK, W. F. *How to Succeed in College.* The outgrowth of a four-year investigation of student capacities and their methods of work.

BOYLSTON, H. M. *Introduction to the Metallurgy of Iron and Steel.*

COHEN, LOUIS. *Heaviside's Electrical Circuit Theory.*

CREW, HENRY. *Rise of Modern Physics.*

KENNELLY, A. E. *Electric Lines and Nets.*

The Manufacture of Pulp and Paper. Prepared under the direction of the Joint Executive Committee on Vocational Education, representing the pulp and paper industry in the U. S. and Canada, v. 4.

MICHELSON, A. A. *Studies in Optics.*

PRESTON, THOMAS. *Theory of Light.* New fifth edition.

ROBINSON, WILLIAM. *Applied Thermodynamics.*

RODGER, E. C. *Careers.* The interviews of nine men each distinguished by outstanding success in a special kind of work. Some of the professions discussed are journalism, business, foreign trade, engineering, and teaching.

For those interested in aeronautics:

BURGESS, C. D. *Elements of Aviation.*

DIEHL, W. C. *Engineering Aerodynamics.*

PRITCHARD, J. L. *Book of the Aeroplane.*

SPAIGHT, J. M. *Aircraft in Commerce and War.*

SPAIGHT, J. M. *Beginnings of Organized Air Power.*

Of general interest:

BYRD, R. E. *Skyward.*

COLLINS, DALE. *Sea Tracks of the Specjacks.*

DILLON, E. J. *Eclipse of Russia.*

EDGELL, G. H. *American Architecture of Today.*

FIRESTONE, H. S. *Men and Rubber.*

FRASER, CHELSEA. *Story of Engineering in America.*

GRANT, J. R. *In the Days of My Father, General Grant.*

HENDERSON, H. W. *A Loiterer in New England.*

MACKENSIE, CATHERINE. *Alexander Graham Bell.*

NEWTON, A. E. *The Book Collecting Game.*

SEYMOUR, CHARLES, comp. *The Intimate Papers of Colonel House.*

SOMEVELL, D. C. *Disraeli and Gladstone.*

STEFANSON, V. *Adventures of Wrangel Island.*

F. P. E. Society

The meetings of the society have been well attended this year although the organization was handicapped by the fact that there was no open hour for meetings. On this account the Freshmen were unable to have the privilege of attending the meetings.

On October 19th Mr. Walter Kriegel of the Insurance Co. of North America gave a very interesting talk on his inspection work in the cotton seed industry. This was followed by several talks on the different branches of insurance by Mr. T. O. Castle, and Mr. W. R. Townley spoke on mutual and stock insurance. Another interesting meeting was held on January 18th at which time the assemblage was addressed by Mr. H. L. O'Brian of the A. D. T. Co. who spoke on the advantages of automatic alarm devices.

OUR VARSITY CAPTAINS

Basketball

John W. Manz, '29

The leader of Armour's five this year is Johnnie Manz, a senior in the mechanical engineering department. Manz was born in Chicago on March 7, 1909. He obtained his high school education at Tilden High School, where he received a letter in soccer. His athletic activities at Armour have been confined to basketball, but his work in that sport has won him his letter and the captaincy.

Despite the widespread opinion that the athlete is not a scholar, statistics generally show him to be an average student. It is

true, however, that he is seldom outstanding along scholarship lines.

Johnnie, however, is one of the exceptions to this rule. His scholastic standing lists him in the upper eighth of his class, and this with his possession of those essential human characteristics, has merited him membership in Tau Beta Pi, national honorary engineering fraternity. He was president of the local chapter last semester. He is president of the Inter-Honorary Council, and is a member of Pi Tau Sigma, honorary mechanical engineering fraternity. He is a member of Beta Psi, and also of the A. S. M. E. With a schedule calling for thirty-seven hours a week of work in the classroom and probably almost as many hours scheduled for his outside activities, he is an outstanding exponent of the idea that hard work along interesting lines is great sport and can be made to leave time for the more social side of life.

Talking Pictures Demonstrated at General Assembly

At a General Assembly held under the auspices of the Armour branch of the A. I. E. E., the student body and the Lewis branch of the A. I. E. E. had the privilege of hearing Mr. L. S. O'Roark of the A. T. & T. Company present several reels of movietone sound pictures.

Mr. O'Roark gave a brief talk prior to the showing of the pictures. "The main difficulty in telephone, radio, and movietone work," he said, "is not due to weakness or lack of power but in obtaining pureness of tone and fidelity in the reporting of the vowels and consonants. Distance can be spanned and sound amplified to almost any extent, but it is the difficulty involved in transmitting speech intelligibly that has to date prevented a transoceanic telephone cable."

"No discoveries," Mr. O'Roark went on to say, "have been sudden, or can be credited to one man. They have been the result of years of work of countless scientists. When a group of men set out to discover new things about sound there were innumerable little 'side-doors' that opened to them. Opening these 'side-doors' led to the method of artificial speech and the electrical process of recording phonographic records, one result of which is the orthophonic victrola."

In the movietone apparatus, the sound is recorded on the side of the film, in tiny bands of light and dark lines—a photo-electric cell then picks up the different light intensities, changes them to currents, and the loud speaker makes these currents audible. The screen used contains myriads of tiny holes that let through the sound from the speaker behind and helps to foster the illusion that the screen characters are talking.

The first reel was really a lecture about the telephone and consisted of technical diagrams and was a premonition of possible future class room lectures. Reel number two was a photograph of a laboratory worker describing his work.

A. I. Ch. E.

After about a year of inactivity, the Armour branch of the American Institute of Chemical Engineers has come to life again. This society has been revived through the efforts of a few of the senior chemical students who were members while juniors.

The officers for the year are:
A. J. Stabovitz, President.
J. E. Tarman, Vice-President.
R. C. Linnell, Treasurer.
V. A. Sturm, Secretary.

The officers were very fortunate in securing the time of several very prominent chemists who addressed the society during the past semester. The speakers who gave addresses were: Prof. John J. Schommer, "My Experience as an Analytical Chemist"; Mr. S. L. Redman, Central Scientific Company, "Tools of the Chemist," and Mr. G. E. Marsh of Libby, McNeill & Libby, "Artificial Stones."

Plans are under way to hold a smoker in the near future and also to furnish more speakers throughout the semester.

Purdue University has recently decided to give the student an opportunity to express his opinion of his instructor and the course on a rating sheet specially prepared for that purpose. He is to mark his instructors as to neatness, presentation of subject matter and other qualities; and the student may or may not sign his criticism. Professors will be self-conscious indeed at Purdue.

ALUMNI NEWS

Moscovics Resigns as Stutz President

The recent resignation of F. E. Moskovics from the position of president of the Stutz Motor Co., recalls to the minds of the older professors at Armour Tech that back in 1893 this same Moskovics had the honor of being the first student to register and pay his tuition in the newly founded Armour Institute of Technology.

He studied at Armour Tech only a year, leaving in the spring of '96 to study in Europe, where he took post-graduate courses in technical studies, and obtained his first automobile experience with Daimler and others.

Returning to America in 1893, he has served almost continuously since in the motor industry. In 1900 he engaged in motorcycle racing, and was sales manager for the Continental Tire Company. He became a partner in the parts manufacturing business of the Brandenburg Brothers five years later, and in 1907 designed his first automobile, the Allen-Kingston, which offered the first American competition to European cars in racing. Ralph De Palma, for many years the idol of American racing fans, was introduced to the American public by Moskovics, on whose Allen-Kingston team the late Hughie Hughes also served.

Moskovics was sales manager of the Remy Electric Company of America, Inc., for two years, from 1911, and in 1913 he joined the Nordyke & Marmon Company (now the Marmon Motor Car Company) here, later being elected vice-president, and remaining in that capacity until 1923.

Early in 1924 he was named vice-president of the Franklin Automobile Company, and a year afterward was chosen president of the Stutz company.

While engaged in obtaining photographs, the associate editor was pleased to encounter B. D. Shnable, '14, at the offices of the Great Lakes Dredge & Dock Co. Mr. Shnable is now Division Engineer with that company. Those interested in looking him up will find him in Room 1000, Monroe Building, 104 S. Michigan Avenue, Chicago.

A letter was recently received from Norman B. Olsen, '24, who with Daune Heller, '24, and Eugene M. Clark, '28, has been appointed from the Sixth Corps Area to attend a Cadet Flying School at March Field in California. Norman writes that Heller and he are making progress in their courses and that they are taking a great interest in their work. Both boys have made solo flights, and have many flying hours to their credit.

Harry A. MacClyment, '98, who is in the wholesale tire business in Riverside, California, learned that the boys were in camp, and evidenced his true Armourite spirit by going to March Field and looking them up. Norman writes that they appreciated meeting him very much.

The annual visit of the Bell System delegation this year brought a face that had not been seen in Chicago for some time—E. L. Nelson, '14, as the representative of the Bell Telephone Laboratories, New York. He did his share in interviewing a considerable portion of the senior class.

Nelson's present address is 39 Briarcliff Road, Mountain Lakes, N. J. Perhaps when speaking of him we should say Mr. Nelson, out of respect to the dignity attached to his present position, but despite this he has acquired that rare power of putting a man at his ease with his first words. Many a senior was more impressed with the opportunities to be found in New York by reason of his interview with Nelson.

His new home is about thirty miles from New York. When not over at Whippany, N. Y., supervising the operation of the Laboratories' experimental radio station, he spends something over two hours a day commuting to and from New York City. Although only an hour or so from the big city, we understand that wild deer are sometimes seen on these commuting trips. Nelson claims he has a lake in his back yard where swimming is in order during the summer months

The "Utility Bulletin" of the New York State Committee on Public Utility Information gives the following novel definition of electricity:

"Electricity is something that starts the Lord knows where and ends in the same place. It is 1/36 of a second faster on its feet than its nearest competitor, backyard gossip, and when turned loose in Europe will get to the United States five hours before it starts. Nobody knows exactly what it is because it has never stood still long enough to find out.

"Electricity is sometimes known as science gone crazy with the heat, and if you can understand its maneuvres you can do anything with it except open a can of peanut butter at a picnic.

"Electricity was locked up in ignorance for centuries until Ben Franklin let it out with a pass key, and since then it has been pulling off more new stunts than a pet monkey.

"With it you can start a conversation or stop one permanently, cook dinner, curl your hair, press your trousers, blow up a battleship, run an automobile or signal Mars and many more things are being invented."

Alumnus Appointed State Architect

Charles Herrick Hammond, '04, has been appointed State Architect by Louis Emmerson as one of the governor's first appointments after his inauguration in January. Mr. Hammond is one of the Chicago architectural firm of Perkins, Chatten & Hammond in Chicago, with offices in the Burnham Building at 160 North LaSalle Street.

Mr Hammond graduated from the Armour Institute of Technology from the department of architecture in 1904, and has achieved much prominence in that profession. He is at present the President of the American Institute of Architects.

Future Luncheons at Chicago Engineers Club

Recently the Chicago Engineers Club, located at 314 Federal Street, offered the services and use of their club for future monthly luncheons on a very attractive basis. They have new and better quarters and more of the facilities of club life than are available at Maillard's Grill. After inspection of their quarters and an agreement upon the prices and guarantee, it was decided to hold the next luncheon (March) at their club.

It is hoped that the change will be beneficial and it should be because a great majority of our alumni are engineers, many of whom are affiliated with the Engineers Club. Members of the club will feel right at home and those who are not members should feel easier in the engineering environment. The change also will afford an excellent opportunity to tap another section of the loop for an increase in attendance at these luncheons. There have been complaints about the luncheons held at Maillard's being too far east for many alumni. We hope eventually to locate some place suitable to the majority with respect to time, location, and, above all, food and service. Why not resolve right now to attend the next luncheon at the Chicago Engineers Club.

From the Alumni Office

After the mailing of a general letter from Sec.-Treas. T. K. Pfafflin in which he made his annual call for alumni dues, there were received a great many letters of complaint.

These came from alumni who hold life memberships and are not in consequence to pay yearly dues. We feel that Mr. Pfafflin is to be congratulated inasmuch as he provoked signs of life in some alumni from whom we have had no word for years. However, letters from those alumni who become indignant because they received a notice for dues which was mailed to all of the alumni, were not in order. We wish that in the future those alumni who hold life memberships after once being assured that they are so credited, would simply disregard any general letters calling for yearly dues.

At present there are approximately about 90 life members out of a total of about

3,250, and inasmuch as the letters are prepared by a letter service company and the envelopes addressed from the addressograph plates kept by another company, it costs considerably more than the amount of the yearly dues received from several alumni to check so as to see that those 90 life members do not receive a particular letter. Besides the charge of $1.00 an hour for work on the addressograph lists we would, as has happened before, very likely have them thrown in such disorder that they would be useless thereafter.

The office of Secretary-Treasurer is one which requires great attention without recompense. It is annoying while performing the functions of that office to receive sharp letters of rebuke from alumni from whom we would not otherwise hear.

W. W. Gothard, '27, a member of the Alumni Board of the Engineer, is now connected with the publication "Domestic Engineering." "Bill," who was editor of Vol. XVIII of the Engineer, found the old hankering for editorial work too strong, and jumped back into the swim. While few of the men who serve on the student publications make editorial work their life work, we are glad to see that the experience gained in such work has proven of value to one of our more recent predecessors.

Another face brought to the Institute by the visit of the Bell delegation was that of Fred Schmidt, '12, of the Personnel Department of the Western Electric Co. He is that company's contact man for Armour. Earlier in the year he addressed the student branch of the A. I. E. E. on "The Technical Man in Industry."

Kent Parker, '28, erstwhile globe-trotter, is now spending his time traveling around the state of Minnesota in the employ of the General Inspection Bureau of that state. Watch for an article describing his travels and a bit of advice to prospective globe-trotters—it will appear in an early issue of the Engineer.

E. M. Pinkerton, '09, of the Minneapolis office of the General Electric Co., dropped in with the G. E. delegation. He reports that there are many Armour grads in vicinity of the Twin Cities.

R. E. Marks, '19, a graduate of the mechanical engineering department, took his own life on Feb. 20. Despondency over poor health is believed to have driven him to despair of success in the business world. Since last summer he was in business for himself as an industrial engineer. He had previously worked for the American Steel Wire and Gauge Co., and for the Illinois Steel Wire Co.

Marks was a sergeant of ordnance in the artillery forces during the World War. He also was a first lieutenant in the Officers' Reserve Corps.

Peterson, '26, Enters Finals for Beaux Arts' Paris Prize

The announcement of the eight winners in the Second Preliminary Exercise for the 22nd Paris Prize of the Society of Beaux Arts Architects contains the name of Jay Edwin Petersen, '26. Mr. Petersen, sophomore instructor at the Art Institute, received his Masters degree from the Institute last June. He is now a licensed architect.

The Second Preliminary Exercise was a twenty-four hour problem—the drawing of a casino, and was entered by twenty-five men. Mr. Petersen goes to New York in April, where the final preliminary will be held on the second and third This is a thirty-six hour problem and is a sketch in adanced design The four winners in this exercise will make a complete rendering of the previous project as the final problem, which will take four week's time. The final winner receives $3,600, and travels abroad for two and a half years, during which time he is privileged to study at the Ecole des Beaux Arts.

The award of the Paris Prize, considered the highest honor in architectural circles, has only once been won by an Armour man —Harry K. Bieg, '24. He captured the 17th Prize. We hope that Armour may again win this coveted prize, and wish Mr. Petersen good luck in the final competitions.

My Philosophy

I allus argy that a man
Who does about the best he can
Is plenty good enuf to suit
This lower mundane institute—
No matter of his daily walk
Is subject fer his neighbor's talk,
And critic-minds of ev'ry whim
Jest all git up and go fer him!
It's natchurl enuf, I guess,
When some gits more and some gits less,
For them-uns on the slimmest side
To claim it ain't a fare divide:
And I've knowed some to lay and wait,
And git up soon, and set up late,
To ketch some feller they could hate
For goin' at a faster gait.
My doctern is to lay aside
Contentions, and be satisfied:
Jest do your best, and praise or blame
That follers that, counts jest the same.
I've allus noticed grate success
Is mixed with troubles, more or less,
And it's the man who does the best
That gits more kicks than all the rest.
—*James Whitcomb Riley.*

John V. Hogan, x26, for ten and a half years kept to himself the story of his gallantry under fire in France, but on March 4 an announcement from the War Department at Washington revealed that he had been awarded the distinguished service cross.

While he himself is still reluctant to discuss the deed that won him the honor, the War Department citation gives the facts. On Sept. 12, 1918, Hogan, a private of the 355th infantry, 89th division, displayed extraordinary heroism in action near Bois de Mort Mare. The detachment which he commanded encountered an enemy machine gun crew delivering effective fire. Hogan placed his men under cover, advanced alone without orders, killed the machine gunner and another man and captured the gun with ten prisoners.

Armour Club Formed at Aurora

The "Aurora Armour Club," an alumni association having for its purpose "the promotion of the best interests of students in the high schools of Aurora who are studying or contemplate studying the profession of engineering, and the sponsoring of good fellowship among these men and the Armour alumni residing in the vicinity of Aurora," was formed January 23 at a banquet at the Aurora-Leland Hotel. C. I. Carlson, '19, was elected president, H. W. Mullins, '30, vice-president, and R. A. Winser, '08, secretary-treasurer.

Besides a dozen and a half Auroranites now attending the Institute, the following graduates promised to make the association a live one: F. W. Twitchell, '99, R. A. Winser, '08, E. D. Kaser, '11, Daniel Roesch, '04, C. I. Carlson, '19, and J. T. Even, '28.

World's Fair Discussed at Mid-Winter Banquet

The Palmer House was the scene of the annual mid-winter banquet of the Alumni Association on Feb. 26. An unusual program was presented, the main theme being the World's Fair of 1933. Mr. Allen D. Albert, assistant to Mr. Rufus C. Dawes, President of the Chicago World's Fair Centennial Celebration, was the speaker of the evening. Mr. Albert has specialized in the causes of city growth and programs of city development since 1906, and is now a sort of "clearing house" for all plans and information regarding the World's Fair. Some time ago he lectured on the Fair at a General Assembly of the student body. His talks were illustrated with unusually fine slides showing proposed buidings and landscaping of the Fair grounds.

The attendance at the banquet was approximately 125. A booster organization having representatives of every class from '97 to '28 was formed to get the large crowd out for the evening. It is hoped that such a committee will serve in a like manner for all coming alumni affairs.

The local editor was pleasantly surprised on February 17th to hear a familiar voice on the phone say, "This is Felix." It was L. F. Pfeiler, E. E. '27, who was in Chicago for the Midwest Power Show. He is Steam Engineer for the Wisconsin Power and Light Co. and is now locatel at Madison. He recently installed a new plant at Beaver Dam and is much interested in his work. (Think of that for an electrical who started the radio station at the Institute and operated it during his "spare" hours.) However, we're glad to know that he is getting on so well. He hasn't changed a bit, but he, and we, will openly admit that he is a little more serious—even perhaps in using his "Gebhardt," for it has become his "Bible."

A letter received last month from H. W. Youngberg, '09, advised us of the death of A. A. Ebert, '09, on October 13, 1928. The Alumni Office was very sorry to learn of his passing and wishes to extend to his close friends and relatives its sincere sympathy.

Mr. Ebert left a wife and six children to mourn his loss as well as an aged mother and two sisters. For years he had been employed by the Mead Morrison Manufacturing Company in their Chicago office. His office associates in that company held him in high esteem because of his ability and character.

R. F. Jensen, '11, stopped in at the Institute early this month. He is now associated with the Gally Building Specialties Co., 612 N. Michigan Ave.

WHERE IT WAS NEEDED

Physician—"Your husband must have absolute quiet. Here is a sleeping tablet."

Patient's Wife—"And when do I give it to him?"

Physician—"You don't give it to him—you take it yourself."

They call it crazy rhythm, but it's just loco-motion to me.

He—"Have you ever been kissed before?"

Co-ed—"Y-y-y-es, 'c-cause I n-n-never could s-s-say n-n-n-n-no fast enough."

—Michigan Technic.

Then there was the absent-minded college professor who addressed a freshman class as "Gentlemen."

HE KNOWS WOMEN

Wife—"Remember now, meet me at the Biltmore for lunch at twelve."

Lawyer—"Very well, dear, but please be there by one, as I have an appointment with a woman client at two and can't wait any longer than three if I am to meet her at four."

—Judge.

Stew—"Whash ya lookin' for?"

Cop—"We're looking for a drowned man."

Stew—"Whash ya want one for?"

A college man is a man who walks through a revolving door without doing his share of the pushing.

Li'l pickaninny
Looks just like his poppy;
Don't know what to call him,
'Less its Carbon Copy.

—Penn Triangle.

"And so you are the gentleman who is giving my wife art lessons? What sort of a pupil is she?"

"Well, I find her very apt, to say the least."

"That's funny. I find her very apt to say the most."

GIGANTIC CONTEST LAUNCHED

Prompted by a sinister spirit of revenge we take pleasure in announcing a combination cross country, ping pong, and cross word puzzle contest open to our faculty. A handicap of two field goals will be allowed those professors who are in the habit of asking questions such as "Who Is What, and When?" and "Why Is Which, and How Is What What?" We realize that such men could not possibly marshall their thoughts in time to solve the problem within the required time, hence the handicap.

This contest closes April 15. Answers must be in handwriting, double-spaced, on neither side of number six paper. All contributions which exceed 837.5 words must be bound in manilla covers.

"SPUNK"

A little cork fell in the path of a whale
Who lashed it down with his angry tail,
But in spite of his blows, the cork quickly arose
And floated serenely before his nose.

Said the cork, "You may flap and splutter and frown,
But you never, no never, can keep me down;
For I'm made of stuff that's buoyant enough,
To float, instead of to drown."

—Security Mutual Roster.

THE PRIZE—to all who solve this simple problem with an accuracy of two-thousandths of one per cent, we will give a year's subscription to the Armour Engineer, tied with a pink ribbon.

SPECIAL NOTICE: Mathematics professors are not eligible for this prize, but if they wish to compete, and they meet all requirements, they may secure a two-years' subscription for the price of a one-year's.

And now—THE PROBLEM—which illustrates the difference between engineering judgment and guesswork:

If there were about 100,000 Swedes in the battle of Copenhagen, and 10,000 were killed, and 10,000 hid in the weeds, and the 326 remaining officers lined what was left up in 50 rows with the same number in each row; then if 301 officers died of diptheria and 3,698 soldiers were shot at sunrise, and the remaining officers lined the rest up in 1,172 rows (with an equal number in each row); then exactly how many were there in the first place?

And now, dear teachers, commence. Boy—120 pencils and 60 pads of paper, quick!

DENIED THE ALLEGATION

"Then you deny," said the magistrate, "that you were rude to the policeman when he asked to see your license?"

"Certainly, sir," said the motorist, "all I said was that from what I could see of him, I was sure his wife would be happier as a widow."

And when Cohen died, his will contained a suggestion to his partner that he take some other clever man in with him at once if he expected to do any business.

Diner—"Waiter, give me my coffee without cream."

Waiter—"Sorry, sir, we have no cream. Will you have your coffee without milk?"

A kiss to a young girl is Faith; to a married woman is Hope; and to an old maid is Charity.

RED HOT PAPA

"Did you notice what time the master returned last night, Martha?"

"No, I did not, mum—but at 7:30 this morning his shoes was still warm!"

—Penn Triangle.

Chewing-gum has gained a foothold in many walks of life.

Statistics show that since the short skirt rage started, railway and street-car accidents have been decreased about 50 per cent. Will such accidents be totally abolished?

THE FRENCH ARE A FUNNY RACE

The Frenchmen craved peace so much that they married the girls on the Rhine. This is no way to stop war.

Pro—"Does your girl skate?"

Con—"Oh, yaas, off and on."

Pro—"Funny, I asked her where she does most of her skating and she ups and whams me."

She (teasing him over the phone)—"Now, do you want that date awfully bad?"

He—"I sure do."

She—"Well, then you'll have to find someone else—I'm not that kind of a girl."

ANOTHER ROFFEE INVENTION

Our readers will doubtless recall that in our November issue we made known Mr. B. H. Roffee's startling invention of the mechanized pogo-stick. With the great amount of talk regarding farm relief that has occurred recently, we feel that the latest invention of Mr. Roffee's is most timely, and we therefore take great pride in forwarding to our readers the very latest information available on the mechanical rooster.

Those familiar with chickens know that eggs are left in the nest to induce quantity production upon the part of the hens, and, to cut down the overhead, these natural products are very frequently replaced by glass eggs. Early in his career Mr. Roffee discovered that roosters did not lay eggs, thereby lessening one source of profit upon the farm, and so he set his fertile mind at work to find some method of eliminating the rooster. As a result of his research we have the mechanical rooster.

This majestic fowl, as it clatters in and out amongst the hens, making its rounds with a clocklike regularity, presents a most striking appearance and reminds the observer of some product of the fertile mind of Jules Verne or perhaps some strange creature from "The Lost World."

Upon close inspection we see it as a masterpiece of hydro-mechanical construction and that only one well versed in art and literature in general could produce such a work. The very posture of the grand old bird as he struts around uttering the melodious bird call with which the hens are kept safely at home shows that the designer has made a deep study of articulation and kindred subjects.

Now we get to the hardly less fascinating technical details of the construction. Water is used as the motive power. At the side of the coop we see a large receptacle which contains water, and which is set at such a height that the spout from its base is on a level with the head of the mechanical rooster. The spout is held in a horizontal "off" position by a spring; when the spout is pulled down, water from the reservoir flows through.

To start the rooster, he is placed in the rack in front of the water reservoir and his beak placed on the water spout. The weight of his head pulls the spout from its horizontal position, allowing water to flow from the tank down the rooster's beak and into his interior. As soon as the rooster's interior reservoir is filled, the weight of the water acts through a flexible cable and pulls his head up to a nearly vertical position. The spout is thus released and the spring pulls it back, shutting off the water from the reservoir.

Slowly but surely, as the water begins to flow from his upper regions over his self-contained paddle wheel and then down one of his cast iron legs, the bird backs away from the coop and begins his monotonous tour of the chicken runway.

This movement continues until the water in his reservoir runs low, and then the rooster pauses and again makes his stand in front of the coop. As the water slowly ebbs away, its weight becomes insufficient to support the rooster's head, and it falls forward upon the spout. This again releases water from the receptacle upon the coop, and the bird's reservoir again begins to fill. Action then continues as previously described until the water in the reservoir on the coop is exhausted.

An exceedingly interesting feature is the "crow" used by the mechanical rooster. In contrast to the usual rooster's call, that of the mechanical rooster is a melodious warble which issues from his artificial larynx in a most appealing fashion. The construction is very similar to that of the so-called canary call, which consists of a whistle containing water. This "crow" may be set to occur at any predetermined time, and awakens one in a much more satisfactory way than does the common alarm clock.

The mechanical fowl eliminates a large part of the expense of the farm by reducing the feed bill. All that it requires is re-oiling every 150 miles, although careful attention must be paid to the grade of oil used in order that the action may be equally free in summer and winter.

We are certain that this latest invention of Mr. Roffee's is the one thing that has been lacking to the poultry industry for many years and that its commercial production will be awaited with great eagerness.

COUNT FOURTEEN

Gene Tunney has visited the Prince of Wales. Gene has had a friendly feeling for royalty ever since he was saved by a count.

—*St. Louis Times.*

Many young men throw themselves into anything they undertake. Some of them should dig a well.

Most Scotch athletes are muscle bound. They just can't loosen up.

When the baby cries for castor-oil, give him a Lucky Camel.

It is said that Horatius was the first to challenge anyone at bridge.

It has been said that we attend college to improve our faculties. It appears that some of them need it badly.

One—"Why is that girl sitting way off there by herself?"

Tother—"Oh, she's just a Maid of the Misses."

Many a girl walks home because she is being chaste.

Tears turned to smiles at father's bier.

VOT'S DAT, BEGORRA?

"What name are you calling?" asked the telephone girl over the wire.

"McCohen."

"I beg your pardon."

"McCohen."

"One moment please, the wires are crossed."

—*Tech Times.*

IMPLACABLE

A man recently fainted three times at his own wedding, but it was no use. They waited until he recovered and he was married just the same.

Daddy—"How would you like to go to the party with me next Saturday?"

Peaches—"Oh, I'd love to go."

Daddy—"Fine; that's just the kind of a girl I was looking for."

—*B. H. R.*

Times have not changed. In Homer's time many a young maiden would sit up all night to listen to a lyre.

Paris says the short skirt must go. Which way?

A hunter was shot by mistake for a duck. His last words were: "Tell my friends that I died game."

Many prohibition agents are able to save $10,000 a year from a $2,000 a year salary. Maybe their saving is from their toothpaste.

A FEAT FOR THE HANDS

Virgin country is land where the hand of man has never set foot.

A reformer is a person who doesn't want you to enjoy what he hasn't the nerve to do.

Dedicated to the freshmen seen scurrying around the first day trying to get signed up:

SCHOOL DAZE

Freshmen, wrinkle not your brow,
You'll get work right soon—and how!
All the profs are waiting—yes,
Just to give you what?—now guess!
Not amusement which you find
In schools of almost any kind.

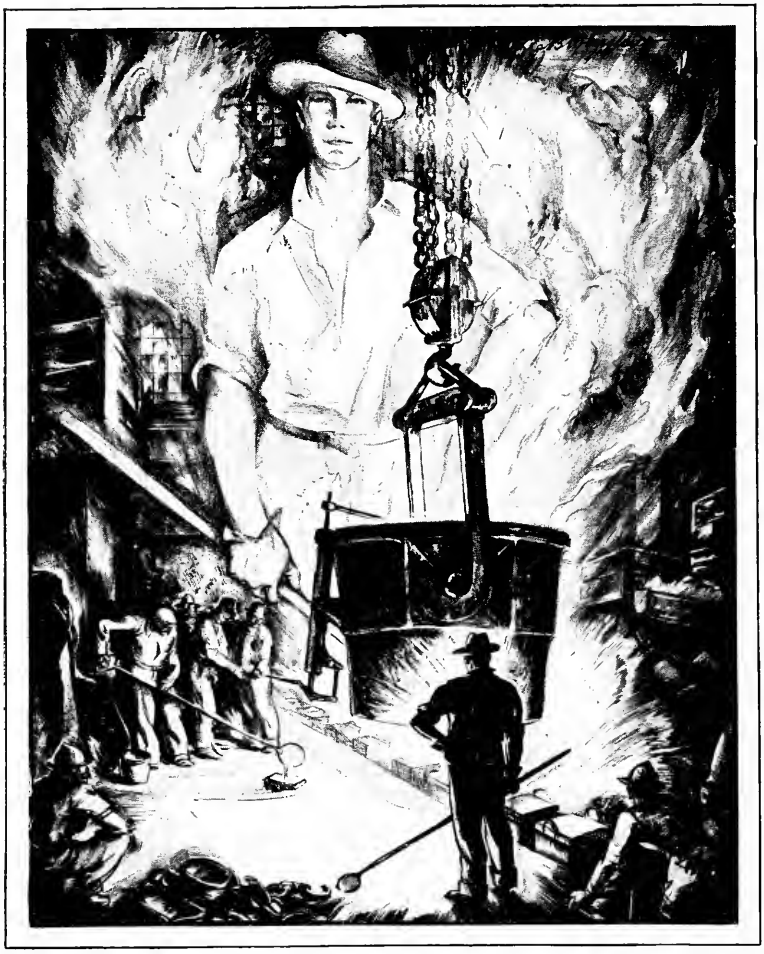
School days never seem to end,
So listen careful to a friend.
Lose not pleasure or your joy
While you study here, my boy—
For men have laughed and yet worked up
Since days when Hector was a pup.

So laugh and have you fun—by heck!
While you're attending Armour Tech!

—*B. H. R.*

Like Lincoln and Jackson, Lindbergh is one of the plane people.

The world's greatest kidder is the man who makes paper towels.



Mould the man first, then the metal

THE CHICAGO RIVER STRAIGHTENING

(*Continued from page 87*)

tion for the purpose of later filling in the old channel, but as such a procedure would involve the occupation by wasted material of land necessary to railroad purposes, it was decided that the material excavated from the new channel would be either wasted in the lake or delivered to the South Park Commission in connection with its work upon the Lake Front.

The proposed new channel would be located upon land at present occupied by railroad tracks, these tracks being an essential part of the terminal facilities of several of the railroads. It was necessary, therefore, for a construction program to be adopted which would provide for the maintenance of these railroad facilities.

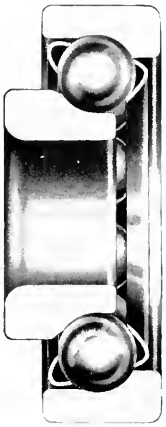
Fundamentally, the theory upon which the construction plans were based was that the area occupied by the proposed new channel, including not only the area within the permanent wharf line, but also a space on either side which would be used for construction purposes, would be freed from railroad occupation; that the tracks of the Baltimore & Ohio Chicago Terminal Railway Company would be carried over the proposed channel on a new bridge located about 300 feet north of Sixteenth Street, from which point tracks would be constructed that would connect with the existing main line tracks of the Baltimore & Ohio Chicago Terminal Railway Company at or near Roosevelt Road, and that the present bridge of the Baltimore & Ohio Chicago Terminal Railway Company across the river north of Roosevelt Road would be maintained until all of the new portion was excavated, with the exception of a small portion at Roosevelt Road.

In order to make this possible, it was proposed to build a new temporary wharf wall along the west side of the Baltimore & Ohio Chicago Terminal Railway Company tracks at Roosevelt Road, in such a manner as would give a 100-ft. waterway between these tracks and the proposed west line of the straightened river, and that in addition thereto, there would be a 100-ft. by-pass under the tracks of the Baltimore & Ohio Chicago Terminal Railway Company just south of Roosevelt Road.

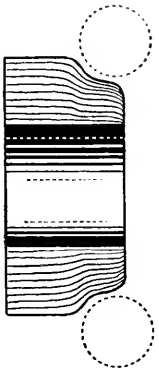
The new bridge carrying Roosevelt Road over the proposed channel would be one of the first things to be started, and the new bridge for the Baltimore & Ohio Chicago Terminal Railway Company at Sixteenth Street would also be one of the first pieces of work started.

The new location of the St. Charles Air Line would be immediately south of the Baltimore & Ohio Chicago Terminal Railway Company bridge. The present structure would be taken down and reconstructed over the new channel. A temporary bridge with a 100-ft. draw would be constructed over the old channel for the St. Charles Air Line during the construction period. After the old channel was filled, the Baltimore & Ohio Chicago Terminal Railway Company tracks would be laid across the filled channel, and the present Baltimore & Ohio Chicago Terminal Railway Company bridge would be removed.

For the purpose of arriving at a value of lands affected by the river-straightening, the Citizens Committee secured the services of B. M. Winston. Mr. Winston made a report giving the valuations of the property in detail. This valuation showed that the property ranged in value on the east side of the river from $16.00 per square foot at Polk Street to $5.00 per square foot at Eighteenth Street, and on the west side of the river from $7.00 per square foot at Taylor Street to $4.00 per square foot at Sixteenth Street. Mr. Winston also found that the land between the old channel and the new channel that would be transferred from the west to the east side of the



Half-section of New Departure Ball Bearing showing the contact between the balls and raceways.



Sketch of inner race after upset forging process. Note direction of fibre flow. Actual specimen does not show flow sufficiently clear to be properly reproduced.

"Control of Fibre"

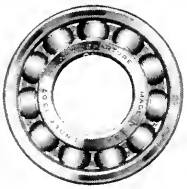
How it Builds Endurance in New Departures

THE exceptional endurance of New Departure Ball Bearings is explained in part by the control of the unseen in steel.

One of these hidden elements is the direction of the fibre in the steel. Where this is kept *parallel* to those surfaces subjected to greater loads, the endurance life is found to be greater than where the load is taken on "end grain" or fibre ends.

By producing bearings by modern upset forging processes, it is possible to control the direction of fibre in the finished forging. The subsequent annealing process relieves any internal strains set up in the steel by forging and the final heat treatment carried out in automatic electric furnaces produces the fine grain essential to the long life of bearings, but neither of these treatments alters the direction of the fibre.

Add to this superiority over other anti-friction bearings the use of a special electric furnace high carbon chrome alloy steel—the most uniformly enduring bearing metal known, the exquisite precision of every part and a 250 percent inspection system—and you have some of the secrets of the remarkable endurance found in every New Departure Ball Bearing.



New Departure Ball Bearings

The New Departure Manufacturing Co.
Bristol, Connecticut
Chicago · Detroit · San Francisco

926

river would be increased in value one-third after the accomplishment of the straightening. He also found that the abandoned channel, after the river-straightening would be completed, would have the value of the land on either side of the channel.

It was evident that in order to bring about the river-straightening project some allocation of property lines was necessary. Accordingly, having arrived at a plan for the readjustment of the property lines, statements were prepared showing the areas of lands to be bought and sold by the several railroad companies, to which were applied the square foot values given in the Winston report, for the purpose of arriving at a cash settlement, as affecting the transactions of each of the railroads in bringing about an adjustment of these property lines. These statements, together with maps, plats, and other data, were submitted to the railroads by the Citizens Committee on September 9, 1925. On December 5, 1925, the chairman of the Committee was able to transmit to the City Council letters substantially accepting the plan, both as to allocation of lands and cash transactions involved therein. There were, however, certain reservations and suggested changes of minor importance.

In the final adjustment, certain departures were necessary from the valuations, specifically in the case of the Baltimore & Ohio Terminal Railway Company, where the application of the Winston valuations would have seemed to have worked a hardship.

The project will cost the City approximately $1,700,000 in order to meet the full cost of the river-straightening project. This is an outside figure, and it is believed that the actual construction cost will be considerably less. In addition to the expenditures to be incurred directly in connection with the river-straightening, there will be the cost of new bridges at Taylor Street, Roosevelt Road, and possibly Fourteenth Street, but as these expenditures would be necessary if the river were not straightened, they are not legitimately a cost chargeable to the river-straightening project.

In conclusion it may be said that the City may have had ample legal authority to condemn land for the new channel and to carry on the necessary construction. It was, however, without legal authority to bring about an adjustment of property lines, and without an adjustment of property lines, the damages which could be sustained would make the cost of the improvement so great as to be prohibitive. With the river straightened, the City will be in possession of full legal power to open streets through the district and assess benefits. Part of these benefits will be public benefits and will be borne by the City as a whole, but a substantial part will be private benefits that can be assessed against property within the assessment district. The policy of the City is that immediately on the acceptance of the river-straightening ordinance, it will proceed in the regular and logical way to open streets through the district.

The author is greatly indebted to Mr. Edward J. Noonan, Consulting Engineer of the City Council Committee on Railway Terminals, for much of the information contained in this article, and for the reproduction of the two aerial maps; and to the Great Lakes Dredge & Dock Company for the two progress photographs.

FROM NEWS TO NEWSPAPER

(*Continued from page* 90)

rotary motion, instead of back and forth, wherever possible; and probably the "web perfecting rotary press," to give it its full technical name, has done as much as the linotype to make modern newspapers possible.

The principle of rotary press work is simple. On one cylinder, called a

"plate cylinder," are clamped the curved plates prepared by the stereotypers, each plate being a curved, reversed image of one printed page. Running in contact with this are several ink cylinders, which feed ink to the type surfaces of the plates as they pass. After the point of contact with the last inking cylinder, the plate surface comes in contact with the web of paper. At the point where the web passes over the plate cylinder, a cylinder called the impression cylinder presses the web firmly on the type.

When the presses start running, the web commences to move, and the cylinder to turn. The plate cylinder, as it spins, gives impression after impression of the type surface to the passing web.

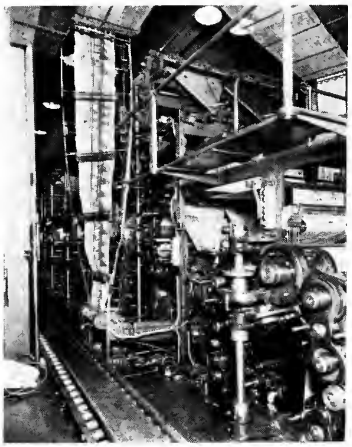
The process as described would, of course, print the web on one side only. But passing the web through another unit of plate and impression cylinder gets the other side printed, so that the web is ready to be cut and folded. Likewise the cylinder has only two plates around its circumference (this is so because the plate bearing type for one page is cast to form almost a semicircle); so that each rotation prints two pages only at that point, and then the press repeats. By making the cylinder long from end to end, four such pairs can be carried, making eight pages in all that are printed from each plate cylinder

Now we can see how a paper is produced. In the simplest style of "press dress," each cylinder takes four pages on each side, or eight in all. With a cylinder printing on each side of the web, the web takes sixteen pages in all. For a thirty-two page paper we would need two such webs. This set-up, however, does not permit efficient folding; so the pages are printed in duplicate. Under this arrangement four webs are needed for a thirty-two page paper, but each turn of the press yields two complete copies.

The Tribune's presses are built so that there are 72 units, each capable of handling one web. By arranging the folders properly, this capacity may be made to deliver papers of any desired number of pages, from 8 to 60 Thanks to their special design and the press lay-out, the Tribune's folders can produce the daily paper in three sections—a feature which is welcome when the paper is divided among different members of the family at the breakfast table.

With the basic principle in mind, we can appreciate many of the ingenious methods developed for making the marvelously productive rotary presses even more productive. First in importance comes the central principle which controls all scientific production—the principle of "continuous routing." The ideal factory receives its raw material at as few entrances as possible, delivers it to the various departments and finally to the assembling room without any of the finished material having interfered with the progress of manufacturing, and without backtracking. This has been done as far as possible in a newspaper way by the Tribune.

The application of this to the business of printing the Tribune begins



This conveyor takes the paper directly from the presses and carries it to the mailing room.

when the paper is received from the Tribune's mills near Niagara Falls. The paper is received at one side of the building at ground level, and is let down chutes to one of the storage rooms beneath the presses. From storage it is moved along the floor of the press-room by hand cars moving on rails, and is fed into the presses from the bottom—not from the sides or top, as is the case with so many newspapers. The finished papers are taken from the presses and carried to the floor above the press-room by automatic conveyors—so there is no crisscrossing or backtracking anywhere in the process.

Another great time saver is the way in which new reels are placed on the presses. The older style newspaper press must be stopped whenever a roll of paper is exhausted, and it remains idle until a new roll is in place. Furthermore, the new roll must often be lifted by pulleys high in the air to its place in the press. The Tribune's special reels eliminate this delay. There are 72 reels—one directly under each printing unit—and each reel holds *three* rolls of newsprint when the press starts operating in the evening. Only one of these rolls is feeding up into the press at any one time.

When the roll is almost exhausted the press is slowed down and the reel is very gradually revolved under electrical control so as to bring the side of one of the upper rolls in contact with the sheet of paper feeding up from the almost exhausted lower roll. The paper of the new upper roll has been smeared with an extremely sticky glue which adheres to the web moving up into the press; whereupon both rolls feed paper to the press.

Momentarily the paper runs double and a few papers are spoiled, but these are thrown out by a "fly-boy" who stands at the folder, so that none of them reaches readers. As the new roll takes hold, the old sheet of paper is cut and the reel revolved still farther. This moves the old core to a convenient position, and it is taken out, clearing the reel so that a new roll may be put in its place. All this happens without stopping the presses for an instant. This ability to run the press continuously means an increase in press production of approximately fifteen per cent.

Other ingenious devices are found in the inking arrangements. Each inking arrangement consists of one ink fountain, one small and one large ink cylinder, one fountain roller, four ink distributing rollers, and two form rollers. With the aid of an ingenious device, all the inking rollers may be set off—that is, moved slightly away from contact with the plate cylinders—at once by the movement of a single lever. This prevents the composition of which the rollers are made from becoming flat at the point of contact with the ink cylinder when the press is idle. At the side of each ink fountain is a set of keys similar to the tuning keys of a piano. By turning these keys the pressman is enabled to adjust the flow of ink to the ink cylinders and rollers. The entire unit is driven by a vertical shaft connecting to the main drive shaft.

The most spectacular work done by electricity in producing the newspaper is by the presses with their extraordinary system of automatic electrical control. There is every safety device possible to protect the employees and give them convenient and absolute push-button control of the press, so that a pressman can slow the press down to stop it from any position in which he happens to be working. The controllers are located on a balcony opposite the center of the row of presses. The motor wiring and control

wiring are carried through conduits to the various motors and press units, and the control wires terminate at each unit in a panel board which in turn is connected to a selector switch. Thus these switches control all the operations of the presses, and are themselves controlled by the push buttons.

There is no more interesting spectacle in the Tribune plant than the row of conveyors which carry papers in a serpentine stream from the floor of the press room up through the ceiling into the mailing room on the floor above. Each conveyor consists of two sets of four spiral wound, wire spring cables, facing each other and running over pulleys. The pressure of these cables against each other holds the papers firmly between them and carries them swiftly upward. Being flexible, the sets of wires may be twisted, and the conveyor thus will carry the papers around corners, twist them to get through narrow spaces, and so on.

As we have seen, the Tribune has 72 printing units, each capable of printing 16 pages on its web. Furthermore, each unit is run at the rate of from 300 to 400 revolutions a minute, or from 18,000 to 24,000 an hour, depending on the strength of the web.

Therefore, the Tribune can print a theoretical total of 20,763,000 single pages an hour. Dividing this by the number of pages desired in an edition gives the number of complete copies that can be theoretically produced under ideal conditions hourly. For a 42 page paper this number would be 432,000 an hour.

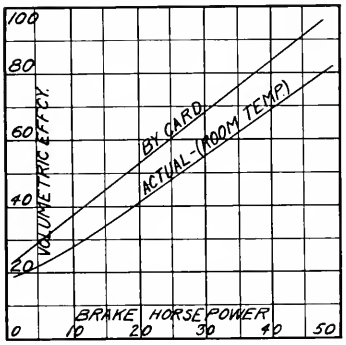
The foregoing description applies principally to the production of daily issues. The same process, however, applies to the black and white sections of the Sunday edition save that only the news and classsified advertising sections are printed Saturday night, the others being handled day times throughout the latter part of the week.

(Concluded next issue)

FACTOR TESTS

(Continued from page 97)

adjustment was not changed during either series of tests. The mixture ratio varied from 13.1 to 1 at the highest temperatures in Test No. 1 to 14.8 to 1 at the lowest temperatures. The corresponding gasoline temperature as measured in the communicating passageway between the float chamber and the jet ranged from 90 to 60 degrees Fahr. No evidence of gas formation was observed as determined by an appreciable loss of power due to leaning of the mixture. Air meter



Students' routine test of a constant speed gaseous fuel engine.

readings were not taken during Test No. 2.

It would appear that the square root formula gives a satisfactory temperature correction value in absence of actual test data of the temperature effects upon the power of an engine. For accurate results the correction factor should be determined for the particular engine and the particular operating conditions. When making temperature corrections, consideration should always be given to whether or not the engine would operate satisfactorily at the standard temperature. It is obviously unfair to credit an engine with increased power at lower temperature than the temperature used during test if the higher test temperature is necessary to obtain satisfactory atomization and distribution.

It would appear that power computed as proportional to barometric pressure will give satisfactory data except in special cases of high pressure—drop intake systems or tests at high altitudes. The increasing importance of the anti-knock value of a fuel indicates that consideration should be given to the ability of the engine to operate successfully at a standard barometer which is above the test conditions. An engine which is tested at one or two inches of mercury below the standard barometer may be at the point of incipient detonation and not operate satisfactorily at the higher barometer. Two inches of mercury correspond approximately to 0.25 change in volume ratio.

Fig. No. 1 shows a diagram of the thermocouple positions and a full scale graph of the B. H. P. vs. temperature data of one test.

Fig. No. 2 shows an enlarged graph of the data taken during Tests No. 1 and 2. The drop in power at the lower temperatures in Test No. 1 is attributed to poor distribution. This effect is also shown in Test No. 2 and emphasizes the importance of limiting the application of the general correction factor.

Fig. No. 3 shows one of the routine student's tests of a constant speed gaseous fuel engine. The gas and air meter readings corrected to room temperature were used for the actual volumetric efficiency and the stop motion indicator cards were used to determine the volumetric efficiency by card. These comparative curves give an index to the increased temperatures of the mixture in the cylinder. In these data the spark advance was at best power for each load.

THE PACKING INDUSTRY

(*Continued from page* 91)

lessly until the desired temperature of chilled carcass is attained, the circulation then decreasing quickly as the refrigeration system is shut down. The temperature to which the carcasses are chilled, if it is desired to cut them up shortly thereafter, is slightly above the freezing point of water, namely 32 deg. Fahr. If chilled below this temperature, the moisture in the animal skin congeals, thereby hardening the surface and making it difficult to cut without preliminary thawing. Where meat is frozen in carcass form for preservation in storage, as is the case with some beef, a thawing process is employed prior to the cutting up of the carcass.

During the various processing stages through which the meat passes, the latter is usually kept in rooms which are refrigerated by brine coils. That is to say, cold brine from the engine room brine coolers is pumped through the coils of the room which it is desired to refrigerate.

As considerable of the product output is sold out of the city, it is transported in refrigerated cars to branch houses in small towns. Various systems have been used in refrigerating cars, the most popular of which are iceing prior to loading, with addition of ice when loaded; or preliminary cooling of the car interior by means of brine circulation through coils about the walls and ceiling of the car, followed by addition of ice to maintain refrigeration during transit. On electric railways, power is available for small portable compression or absorption systems. However, because of the relatively small amount of electrified mileage as compared to the steam mileage, the use of electrical power for refrigerator cars is almost negligible at present.

A new and superior substitute for water ice has been developed, known as solid carbon dioxide or "dry ice." Its latent heat of fusion is 276 B.t.u. per pound as compared to 144 B.t.u. per pound of water ice. In addition, dry ice yields dry carbon dioxide gas into the air of the car, thereby impeding growth of bacteria, while being entirely uninjurious to the product. The only disadvantage of dry ice is its comparatively high cost of preparation, this alone preventing its universal adoption for car refrigeration.

The cost of manufacturing dry ice is $100.00 per ton, as compared to $2.50 per ton of water ice. Dry ice is used at present by some of the larger retail confectioners to preserve ice cream, etc., while in transit. At present, however, this application of dry ice amounts merely to a fad, but in the future, due to cheapening of cost of manufacture of solid carbon dioxide through improved methods, this substance may become an important factor in the refrigeration field for iceing cars, trucks, etc.

Steam generation for the packing plant is required first, for operating steam-driven equipment such as ammonia and air compressors, turbine-driven centrifugal pumps, various types of water pumps of the piston type, injectors, soot blowers, etc.; second, for hot water heaters of the open and closed type, either exhaust or live steam being used, depending on the conditions and requirements; third, for building heating purposes for which exhaust steam mainly is used; and fourth, for miscellaneous meat process work, etc.

As to furnace equipment for generating steam, the powdered coal furnace is gradually gaining in favor over the chain grate stoker because of the former's greater power output per unit area of boiler heating surface. This means that fewer boilers are needed than when the latter are equipped with chain grate stokers, or more briefly, decreased cost per unit weight of steam generated. The packing industry did not accept the powdered coal furnace

as quickly as did the electrical power generating companies, but this is not to be expected of any industrial plants since here the manufacturing of specific products is of primary importance, efficiency of steam generation being comparatively a secondary factor. In contrast, the electricity generating companies require vast quantities of steam for the generation of electricity by means of turbo-generators. Under the latter condition cheapened steam generation means lower unit cost of power output, making it worth while to make large investment in equipment in order to obtain maximum efficiency in steam generation.

The consumption of electrical power by the packing industry is continually increasing. On most new installations of ammonia compressors, the synchronous motor is replacing the old Corliss steam engine as a source of power. Motor-driven centrifugal pumps are replacing turbine-driven centrifugal pumps and steam-driven piston type pumps. Also for supplying power for various machinery, induction motors have largely replaced the reciprocating steam engine. Examples of the above are chain grate stoker drives, ash and coal conveyors, meat grinders, carcass conveyors, dehairing machines, fat cookers, and miscellaneous other machinery used in processing meats and manufacturing by-products.

As the requirements for electrical power have increased by leaps and bounds, the packing plants have found it more economical to buy power than to generate their own. The general trend lies in this direction, the present power generating equipment being largely retained for standby purposes. The reason why packing plants, as well as other large users of power for industrial purposes, are able to obtain lucrative power rates is that the industrial power peak load occurs during the day and during the night when power demand for house lighting, etc., is comparatively low. The object of power generating companies in offering reduced rates to encourage industrial power demand is to attempt to obtain a nearly constant power load, thus putting all their electricity generating stations as nearly as possible on the so-called base load basis of operation. The latter is the most efficient basis of operation, since with a specified equipment, maximum efficiency is attained when the plant is yielding the maximum possible total power output.

It might be said that in recent years there has been a drastic change in point of view with regards to expenditures for improvement in appearance of buildings housing equipment. Some years ago the packing plant in general consisted largely of buildings that appeared ugly inside and out, the main object in putting up buildings, mounting machinery, etc., being merely utilitarian, with little or no regard for appearance. However, within the last ten or fifteen years the personal pride of the packers as well as the natural tendency to keep abreast of other industries has caused a change in policy, fostering a desire that equipment shall be set up and arranged in an orderly manner and that rooms housing equipment be so designed as to admit maximum daylight, and to present a pleasing appearance. Due to the maintenance of general cleanliness and upkeep of appearance by painting, etc., at regular intervals, a show room effect has been achieved in the cases of the newer installations. This policy has been spread to older installations as far as possible and will eventually be applied to every building and the equipment therein.

With regard to the maintenance of cleanliness and the improvement of buildings and equipment in the packing industry as well as in any other, there is a psychological reaction on the part of the personnel in the direction of creating a feeling of pride and contentment in one's surroundings, accompanied by a natural tendency toward increased individual efficiency and output.

ENGINEERING NEWS

(*Continued from page 99*)

tion of a "pool of fire" in the large court facing the river. The effect will be produced by means of graded color in the projectors, whereby the base will be illuminated in a deep red which fades into orange, amber, pale straw, and white at the higher points. The turreted shapes and stone ornaments at the top of the building are to be in silhouette.

The lighting control of the opera stage is unique in that it is so arranged that the stage lighting director will be able to see the effects he is producing. An organ console type of remote control switchboard is located in a pit sunk in the stage apron. This console board will also control the auditorium lighting. One lighting scene may be set up in advance on the control board and put on by the throw of a toggle switch. The remote control system employs the new thyratron tubes, which are similar to radio tubes except that they are used on low frequency circuits. These tubes have already been successfully used in gun-sighting and ship steering mechanisms. The size of the units required for this large stage and the use of chromium plated parabolic reflectors for accurate control of the lighting are other unusual features of the installation.

Col. B. J. Arnold Receives Engineer's Award

Col. Bion J. Arnold, chairman of the board of supervising engineers of Chicago, was given the Western Society of Engineers' Washington award for 1929 recently. The award, a bronze plaque, is voted annually to an engineer who has given "preeminent

service in promoting human welfare through engineering." Former recipients include Herbert Hoover, Orville Wright, and Michael Pupin.

Col. Arnold has been given the award for his "pioneering work in engineering and the economics of electrical transportation." He first received distinction for his famous intramural railroad at the Chicago World's Fair in 1893. Since then he has worked on electrification projects of several railroads. He has been an Honorary Member of the Alumni Association of the Armour Institute of Technology for 18 years or more. He heads his own company, with offices at 105 South LaSalle St., and lives at 4715 Kimbark Ave., Chicago.

A monster fifty thousand watt lamp, having the appearance of a radio tube, has recently been built for experimental purposes. A radiator of metal fins on top of the bulb carries off the intense heat generated by the white-hot tungsten filament, which has a temperature of 5,500 degrees Fahrenheit—twice as hot as molten steel. The lamp is filled wih nitrogen. The circulation of this gas cools the lamp and takes with it up into the radiator any particles of tungsten thrown off from the filament, thus preventing the blackening of the glass walls. Huge lamps of this type may ultimately be used for the lighting of airports and motion-picture studios.

The New York Edison Company is now installing at its great East River Generating Station a 160,000 kw. single-shaft single unit turbo-generator, which is said to be the largest thing of its kind in the world. And there is also being assembled as an auxiliary to this generator a truly enormous Ingersoll-Rand single-pass surface condenser that will be able to handle hourly nearly seven hundred tons of steam exhausted from the turbine that will drive the generator. In order to condense this steam so that it can be turned back into hot water for refeeding the boilers, the steam will be exposed to 90,000 square feet of cooling surface within the condenser. This cooling surface is made up of enough 7/8-inch tubes—each twenty-six feet long—to cover a distance of a trifle less than eighty miles, if placed end to end.

The cooling water sent through the tubes of the condenser in the course of an hour will amount to forty thousand tons—sufficient, in fact, to float a vessel the size of the Mauretania. The condensing water will be drawn from the East River, and will be circulated through the condenser at the rate of 160,000 gallons a minute by two 54-inch centrifugal Cameron pumps. As soon as the water has performed its cooling service in the condenser, it will be returned to the river.

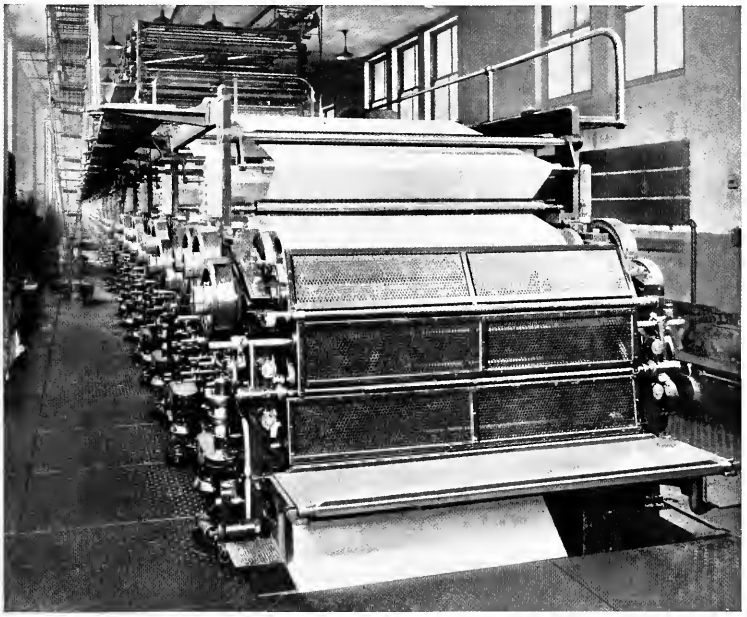
One of the longest bridges in the world and one of a chain of three which, with their connecting highways, form a crescent about the upper end of Hampton Roads, a new highway bridge over the James River near Newport News, Virginia, was opened to traffic in November.

The new bridge is five and one-half miles long, including the approaches, and provides a motor route between Newport News and Norfolk and Portsmouth, thus closing a gap in the Atlantic coastal highway. It is supported by concrete piles weighing up to 35 tons each and 115 feet long. These piles were poured on land, loaded on barges, and towed to the point of operations. There they were placed four abreast, seven feet on centers, and driven two at a time by a gigantic pile driver.

The longest lift span in the world is located about three-quarters of the way across this bridge. It is 300 feet long and its lift is 147 feet above mean high water. When the span is in the raised position, the largest vessels in the world can pass underneath.

The ARMOUR ENGINEER

VOL. XX. MAY, 1929 NO. 4



Published Quarterly by the College of Engineering
Armour Institute of Technology
Chicago, Ill.

Member of Engineering College Magazines Associated

1400-pound pressure at Kansas City

At Northeast Station, the Kansas City Power & Light Company has installed two Combustion Engineering Boilers (Ladd type) each capable of delivering 200,000 pounds of steam per hour and designed for a maximum pressure of 1400 lb. gage.

These units are equipped with C-E Fin Tube water-cooled furnaces, C-E Economizers and C-E plate type Air Preheaters and are fired by Lopulco Pulverized Fuel Systems of the direct fired type.

The difference in investment costs of this high pressure installation and of an installation for 300 lb. pressure is surprisingly small.

At Northeast Station, the fuel saving resulting from the use of the higher pressure is nearly three times the fixed charges on the increased investment.

This installation is an excellent example of coordinated design. The complete fuel burning and steam generating equipment was sold and installed under one contract — one responsibility and one set of guarantees.

COMBUSTION ENGINEERING CORPORATION
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200 Madison Avenue, New York, N. Y.

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COMBUSTION ENGINEERING

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Volume XX May, 1929 No. 4

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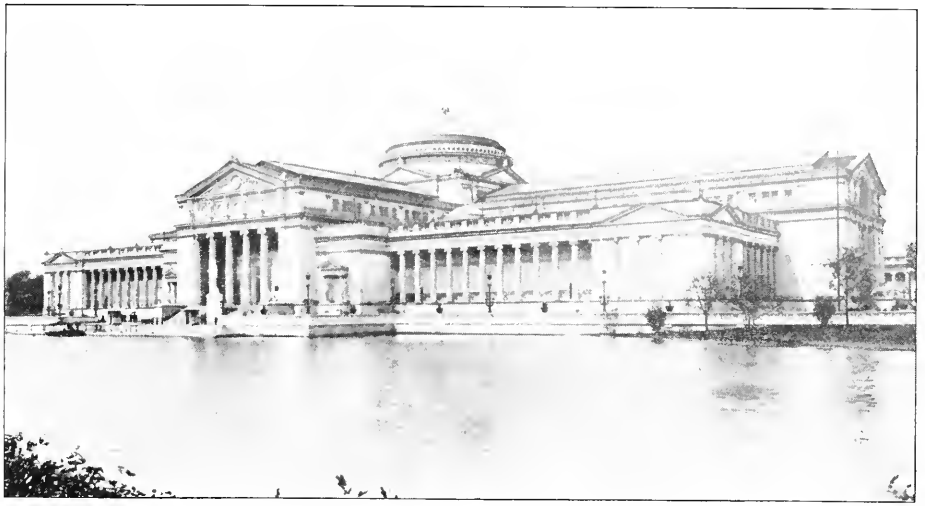
Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.

Entry as second class matter applied for at the postoffice at Chicago, Illinois, under the Act of March 3, 1879.



Old Fine Arts Building, Jackson Park

The
ARMOUR ENGINEER

VOLUME XX MAY, 1929 NUMBER 4

US ENGINEERS DON'T NEED NO ENGLISH

By James C. Peebles, '04

Professor of Experimental Engineering

DURING an open hour a number of sophomores are gathered in the drafting room, making more or less successful efforts to solve some problems in the next day's calculus lesson. So far as unit output, that is, problems solved per student, is concerned, a "math bee" like this is unusually productive of better results than when the work is done individually. Everybody has all the easy problems, but nobody has the hard ones. These are solved only by the solitary thinker, undisturbed by the rabble. From a "bee" like this the gang gets more honey than it deserves, while the thinker very likely gets stung.

Suddenly one student, having collected his unearned increment of honey, slams his book shut and rises from his chair with an air of finality. "I certainly hate these kind of problems, and I ain't going to waste any more of my time on them."

In addition to an erroneous estimate as to the value of his time, this young man is guilty of two assaults on the mother tongue. One is an inexcusable solecism often used by those who should know better, the other a plain vulgarism never heard among cultivated people. Speech like this is the despair of the teacher of English. The lad may know every rule in the grammar, and recognize his errors when they are called to his attention, but still he continues to make them. It is the result of slovenly mental habits usually formed very early in life from bad example at home or elsewhere. Against such a heritage school and college struggle in vain.

In the recitation class in physics sits a young fellow who is finding the course in engineering a bit too much for him. He has been struggling desperately to retain his footing amidst a flood of physics, mechanics, mathematics, but he is being carried slowly beyond his depth. He has tried to solve problems involving zero and infinity, but he feels that he cannot master all that lies between, certainly not in a single semester. When the professor suddenly shoots at him a question, "What is a vacuum?" he dives like a frightened teal into the flood of facts about him and comes up with this: "A vacuum is where nothing fills all space."

Several years ago Professor Peebles was the author of a series of articles entitled "The Unofficial Observer," which appeared in the Armour Engineer, and which were quite popular. "Us Engineers Don't Need No English" is on the same general subject. It is reprinted by permission from the Bulletin of the Society for the Promotion of Engineering Education.

Here is a lad who knows practically nothing about what he is asked to define, and of course his answer is meaningless. If one would speak or write clearly and convincingly on any subject he must first make himself complete master of that subject. The change from a mental to a spoken picture is seldom accomplished with an efficiency of one hundred per cent; there is nearly always a loss in the mutation. If the mental picture is not clear and distinct the spoken or written likeness is very likely to be nothing but a blur. Sometimes, of course, a very clever speaker who has only a superficial knowledge of his subject can trace, in beautiful words and phrases, a feathery arabesque which is highly entertaining to his hearers. They admire his artistry, but they carry away with them no enduring memory of what he said. For most of us precise knowledge is the great prerequisite without which clear written expression is impossible.

The class in valve-gears has just finished a lesson in which this question appeared: "Describe the construction of an eccentric on a steam engine and explain its function." Later, as the professor is reading the papers, he finds this answer to the above question. "An eccentric is a thing on the shaft of the engine to move the valve with. It is held on with a strip of metal in a slot or with a bolt, and it slips around as the engine turns. If it slips too far the engine stops or runs away, as the case may be."

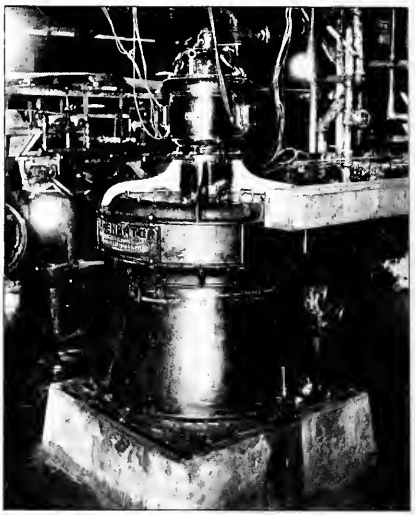
The professor is in a tolerant frame of mind, and he recognizes the germ of an idea in what the student has written. He reads the answer several times, but finally, more in sorrow

(Continued on page 134)

Cornstalks
A Scientific Romance

By I. G. Katz, '30

Student in the Department of Chemical Engineering

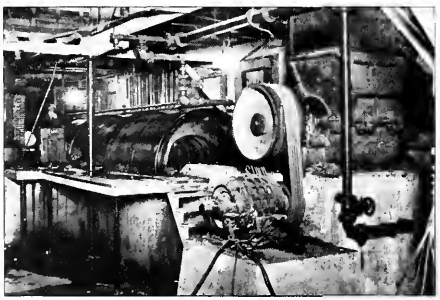


Cornstalk bales are torn into fragments in the crusher (at right). From this point the raw material passes through the wash, fine-shredding, and digesting, with only occasional supervision.

SCIENCE has once more rubbed its mighty lamp, and the genie, from the useless cornstalk, brings forth paper, rayon, celluloid, lacquers, explosives, and cellulose in all its forms. Cornstalks, the nuisance of the farmer, have been established on the market as a standard product and one which will soon rank with the leaders in the production of the invaluable cellulose derivatives. The chemist, who succeeded so admirably in his work with coal-tar and with cotton linters, has not only opened another field of opportunity in the cornstalk, but also a valuable source of income to help solve the problem of the farmer.

The commercial application of cornstalks has been a matter of great interest and a most significant phase of the general problem of utilization of waste products from the land. The tremendous extent of this great cellulose reserve is not always appreciated, although it represents the most readily available source. Cellulose, which takes a tree eighty years to produce, can be obtained from a plant which requires only three months to grow and yet it is a by-product in the production of a money crop of huge value. In 1925, the total acreage of corn in the United States was 101,631,000, and with a conservative estimate of 1.5 tons of cornstalks per acre, this gives a production of 152,446,000 tons of cornstalks. Such a tremendous amount of material going to waste each year with so many valuable possibilities has naturally lured many noted scientists to the problem—that of taking a by-product with practically no value and using its natural constituents to the greatest advantage for all mankind. And who can tell but that some day in the future the value of the cornstalk by-products will exceed in value that of the corn, as the value of the coal-tar by-products have so enormously exceeded those of the coal-tar?

That there was a fortune awaiting some one in cornstalks has been known and realized for about 150 years, yet the cost of production has always exceeded its worth. As early as 1765, a German, Jacob Christian Schaeffer, suggested the use of Indian cornstalks for paper making as a means of utilizing this waste. In 1802, B. Allison and J. Hawkins took out an American patent for a process of making paper from corn husks. Twenty years ago the United States Department of Agriculture undertook an exhaustive study of the possibilities of the corn plant for paper making on a commercial scale, in addition to the customary laboratory scale. Up to the year 1927, more than two dozen United States patents had been issued for possible methods of utilizing the cornstalk; yet nearly all of these methods have proven to be of very little practical value. Previous to the fall of 1927, the solution of the problem seemed hopeless; no process seemed available which could produce cellulose pulp whose price could compare with the market price of pulp from wood.



This machine, weighing 3½ tons, removes the last particles of dirt from the pulp before it passes to the wet-lap machine. This was the first machine of its kind in the U. S.

A scientist of Budapest, Hungary, Dr. Bela Dorner, who was Technical Director of the Government Laboratories, had performed many experiments and tests on the cornstalk for over twenty years. Finally Dorner's process was brought to America. W. Jule Day of New York City gave Dr. Dorner the necessary financial backing and sufficient equipment was bought to make test runs on a laboratory scale. Dorner's process for the recovery of cellulose was one which involved less handling of the raw material than any other which had been tried, and the use of the entire stalk with the exception of the cob and the corn itself. Out of these tests grew the Cornstalk Products Company, which began to construct its present commercial plant at Danville, Illinois, in December, 1927.

On the large commercial scale, however, the problem was no longer the single phase of converting cornstalks into cellulose. The stalks must first be gathered and transported to the plant at the very lowest cost. Professor O.

R. Sweeney of Iowa State College, and an earnest advocate of cornstalk products, recognized in the beginning that the entire problem in cornstalk utilization hinged on the collecting and getting of the constalks to the machines as cheaply as possible. It is well worth noting that the chemical, mechanical and agricultural engineering departments of Iowa State College, have done an immense amount of work in this field. The work represents every step from the corn in the field to the actual manufacture of the commercial product.

Harvey J. Sconce, a man with an enviable reputation as a successful farmer, corn grower, and business man, was secured by the company to head this raw material department. Mr. Sconce saw the necessity for determining as soon as possible the most efficient method of collecting and transporting the cornstalks, and he used the data collected by J. B. Davidson and E. V. Collins to the best possible advantage. These two men, members of the engineering section of Iowa State College, were the first to undertake the problem of determining the cost of collecting cornstalks; and from their work they came to the conclusion that the most economical unit would be had by continuous operation —a combination of mower, hay-loader and hay-baler. Although every conceivable method was used the first year to collect the cornstalks, the most impressive and economical was that in which the grain-harvesting and cornstalk-collecting was combined in one machine.

Through the fall and winter of 1927 and early into 1928, Sconce and his field crew successfully gathered, baled, and delivered to the company's yards 10,000 tons of stalk. The remarkable part of this work is the fact that these stalks were obtained under the most adverse conditions. The season was an unusually wet one and at times the fields were completely submerged. That these stalks under such conditions were delivered to the mill at a price which made the entire proposition attractive commercially, proved definitely that the enterprise was to be

One type of harvesting operation—husker, shredder, and baler working as a field unit. Another type of combine will harvest, husk, shred, and bale.

a success. So ends the first step in this remarkable romance of recovering a waste.

With the stalks at the plant, the preparation of the cellulose is begun. The baled stalks are first broken in a bale breaker, the dust is removed by a cyclone separator, and then thoroughly washed in a rotary washer. Every speck of dirt must be removed in these mechanical operations, for any foreign matter that remains will appear in the final product and mar its appearance and equality. The mechanical treatment not only removes the dust and dirt, but yields considerable water-soluble material that can be recovered. The stalks are then pulverized in a hammer mill, and washed again with hot water. This hot water is recirculated to build up a marketable content of water-soluble, fermentable, organic matter, which will be mixed with the cold-water soluble material and marketed as a by-product. The fiber is now ready for chemical treatment and it is passed into twin vertical digesters. An approximate ten per cent caustic soda solution is added and digestion is carried on at 20 pounds steam pressure for about two hours. As can readily be seen, the yield in quality and quantity that will be obtained will depend on the variables, such as the strength of the alkali, duration and temperature of cook, and others. The kind of pulp desired will define these conditions but in general the aim has been to secure the greatest yield of easily bleached pulp that will produce a satisfactory paper. The liquor from the digester, on neutralization, yields a mixture of pentosans and similar compounds that appear to be suited for use in the manufacture of lacquer and plastic raw materials. Thus, in addition to the pulp, there are two possible by-products of distinct interest to chemical industry.

The fiber from the digester is beaten, and then screened through bronze paper screens with slotted openings of 0.012 inches in width, to remove any oversized fiber. These screens are equipped with vibrating diaphragms to prevent any clogging by the fiber. The pulp, which is now ready for bleaching, is first dewatered

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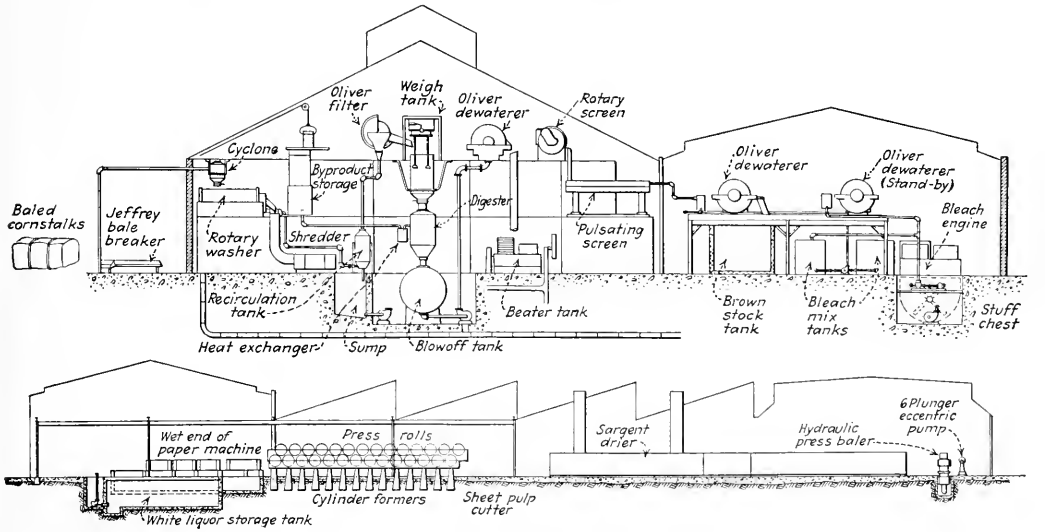


Above: Cross-section through the chemical pulp plant. Below: Paper machine, press rolls, drier, and baler for handling the hydrolyzed pulp.

From News To Newspaper

By J. M. Flynn

Business Survey Department, The Chicago Tribune

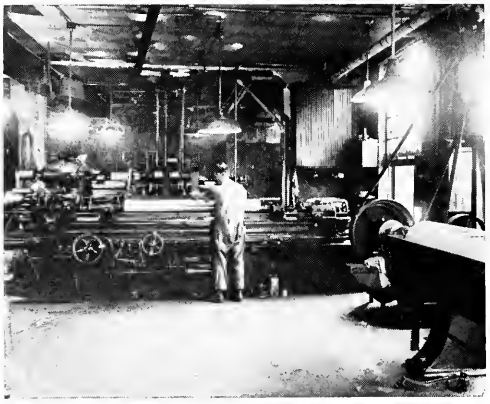
ONE of the outstanding features of the Sunday Tribune is the rotogravure section. The printing method which produces the delightfully soft and "true to life" pictures and accompanying text found in this section, owes its existence to a process invented in England about 1890, and made practical for newspaper use in Germany about 1910. The full story of its career goes back to the days when men first began to think of reproducing text and pictures by printing. It soon became apparent to these early workers that there were three different methods which might be used for printing. The first of these, known as "relief" printing, or "letter press," made its marks by impressing ink on paper by means of raised characters and surfaces. This was the method adopted by Gutenberg, the father of printing, in the 15th century. Likewise it is the simplest and least expensive method—so naturally, it is the process most used for printing today.

The second method is "surface printing." In this method, a flat surface is treated chemically, so that some portions will take ink and others will not. Paper is then pressed against the inker surface, and the ink is transferred to it. The outstanding method of this sort is *lithography* which is used to produce posters of all sizes. Lithography produces striking color effects, and an immense number of copies can be made cheaply, once the expensive plates have been prepared.

There remains the third possibility, known as *intaglio* printing. In this method the design to be printed is cut or etched into the surface of a flat plate or copper cylinder, and the depressions are filled with ink. Next the surface is cleaned, removing all ink except that found in the depressions. Paper is then pressed against the plate, and by taking up the ink, takes the design.

This is the first principle used in rotogravure. The second is the use of a plate made as a cylinder for carrying the depressions. Hence the term "roto"—for the use of such a plate permits high speed *rotary* printing. The trick in the process lies in getting the impressions etched properly into the cylinder.

First the copy to be reproduced—either type matter or illustrations—is worked into the shape needed for the later processes. Type matter is locked up, and a proof is pulled with lamp black ink on a transparent onion skin paper, this proof being technically known as a "lampblack." Illustrations are photographed, yielding negatives. The photographic negatives are retouched if necessary and then positives are printed on transparent paper. The positives, too, may be retouched, and reduced or enlarged in comparison with the size of the original. Thus both type and pictures are in the form of positives on transparent paper. Everything is ready now to make the "resist" with which the copper cylinder is etched.



Special lathes give the copper cylinders a glass-like surface before they are ready to be etched.

Since an entire cylinder must be etched at once, positives of all material—type, pictures, borders—must be handled together. The first step is pasting everything down, according to layout, on a large plate.

A specially constructed frame is used guiding the layout man in getting accurate "register" on the plate as a whole. Then the different pieces of copy to go on the page—lampblack proofs in the case of type, or transparent photographic negatives, carefully made to the size they are to reproduce—are laid in position on the glass plate, and pasted down along their edges by means of strips of gummed paper.

When the pasting is complete the glass plate bears, in effect, an accurate photographic positive of the job to be turned out. It is worth noting, too, that this "pasting down" is the part of rotogravure which makes the copy and art requirements for rotogravure advertising different from those for letter-press. It has been found, for one thing, that attempts to make photographic reproductions or enlargements from proofs of type matter result in positives which are too gray to reproduce well. The only thing sharp enough is a lampblack proof, pulled from the type itself. Type, therefore, must be set accurately to size, carefully locked up, and lampblack proofs taken.

Illustrations on the other hand, are handled by means of photographic reproduction. Hence reproduction or enlargement of the original copy is possible. Also, in order to obtain a uniform effect in the finished job, the reduction should be the same for each piece of illustrated matter used.

After this huge plate has been prepared, with all the photographic positives pasted on it in their proper places, a piece of special tissue paper is sensitized and placed directly next to the positives, in a large printing frame. The plate and paper are covered with an air tight rubber-blanket, and all the air is pumped out from beneath the blanket. The resulting pressure on the outside holds the plate and the paper tight together, eliminating all chance of trouble because of puckering or bulging; and the whole "set up" is exposed to light from a powerful bank of lamps. This transfers the picture of the assembled positives to the sensitized surface of the tissue paper.

Next the picture positive is removed and a fine ruled screen similar to that used in making half-tones, is placed over the carbon tissue. The tissue is again exposed to light, thus superim-

posing the lines of the screen upon the pictures. The sensitized paper now is ready to go on the cylinder.

The cylinder on which the etching is made consists of a steel core on which copper has been electrolytically deposited. The cylinder is then ground and carefully polished to present an even and perfectly smooth surface. The copper cylinder is then placed in a troughlike structure and the tissue paper is placed on the copper cylinder, care being taken that it is laid in the exact position to a minute fraction of an inch, that it is to occupy on the cylinder. Now the cylinder, with the paper on it, is soaked in warm water until the paper backing of the tissue is softened. It is then peeled off, leaving the sensitized gelatin surface on the cylinder. This surface is what the rotogravure man calls a "resist." The cylinder with the transferred gelatin film is then rotated in a tank of hot water, after which it is cooled and dried.

We have now a cylinder bearing an image of the "printed" pages of the rotogravure section, save that the type and pictures are still photographic—i. e.; they have not yet been etched into the cylinder, so that they will print.

Before the etching starts, the edges of the subjects are blocked out with asphalt varnish. Likewise all margins and other surfaces of the cylinder that are not to print, all blemishes, holes and light spots. Otherwise the etching acid would attack these exposed parts, and cause indentations on the surface of the cylinder which would fill in with ink when printing and cause dark spots or streaks.

When the exposed spots have been covered with varnish, the cylinder is placed in the etching trough, and the etching fluid—perchloride of iron—is applied. The operator revolves the cylinder slowly, judging the progress by the discoloration of the copper. The etching is judged complete when the cylinder is a dark color all over.

After etching, the asphaltum protection is removed with benzine, and salt and acid are used to clean out the cups. Some correction of defects is possible at this point. Light spots which are not wanted may be removed or burnished out altogether, and dark spots may be filled in to print lighter.

Once the etching is finished, the difficult part is done—for even though the presses are the most expensive part of the equipment for the rotogravure process, the principle is simple. The engraved cylinder revolves in a veritable bath of ink. After turning out of the bath, the surplus is wiped off clean by means of a steel knife known as the "doctor blade"—

A view of the roto press room, showing a few of the 28 press units.

a thin, flexible knife of steel which is drawn obliquely across the full width of the etched cylinder so that its surface is scraped free from ink, except in the cavities or wells. The ink is thinner than that used in letterpress printing, and the "doctor" can remove it easily. The "doctor" not only shears the ink off the etched part of the cylinder (leaving the cavities full), but entirely removes it from the plain surfaces where the plate is not etched, thus leaving clean margins on the printed sheets.

At the top of its turn the etched cylinder comes into contact with a rubber blanketed cylinder—or rather, it would if it were not for the fact that the web of paper passes between the cylinders at this point. Here is the point at which the ink in the little cups is transferred most peculiarly to the paper. The rolling action of the hard copper cylinder and the soft rubber operates to create a vacuum at the point of contact, and this draws the ink out of the cups and on to the paper.

Because of the varying depths of these cups, after being transferred the ink lies thicker or thinner on the paper to give the desired lights or shadows. At this stage occurs the phenomenon to which much of the beauty of rotogravure is due. After the ink has been transferred to the paper, it spreads across the thin lines which retain no ink, and joins with the ink from neighboring cups, combining to make the resultant picture closely resemble an actual photograph. Thus, while a screen was used in order to make possible the transfer of ink from the cylinder to the paper, the "screen effect" almost disappears after printing and the desired effect of a continuous shading across the entire picture is obtained.

All the Tribunes printed—and there are over 6,000,000 printed every seven days—go through the "mailing room." The term, "mailing room" is somewhat of a misnomer for while this department is a mailing room it is also a good deal more than that. In addition to handling all Tribunes which are mailed it also bundles all the papers that are delivered by truck and wagon to newsdealers and the official carriers who handle the deliveries to homes. It is the clearing house for all the circulation, and is elaborately equipped and organized to fulfill its function.

As might be expected from a department which must be able to handle around three-quarters of a million pounds of paper, distribute it to the four corners of the earth in units as small as three-quarters of a pound, and do it all in seven hours at most, machinery is used from the instant the papers come up from the pressroom on the floor below. As the thirty mechanical conveyors pour forth their endless streams of folded newspapers, a horizontal conveyor or "endless belt" carries the papers past the stations of the different machines. At each station, men take off papers as needed, and prepare them for their

(*Continued on page* 150)

Light Weight High Speed Diesel Engines

By M. J. Kittler, '29

Student in the Department of Mechanical Engineering

THE Diesel engine has been used for marine and power plant work for over twenty-five years. It has been well suited for this class of service since it is economical and reliable. These engines are very heavy, weighing from one hundred to five hundred pounds per brake horsepower, and rotate at fairly low speeds, from 75 to 200 revolutions per minute.

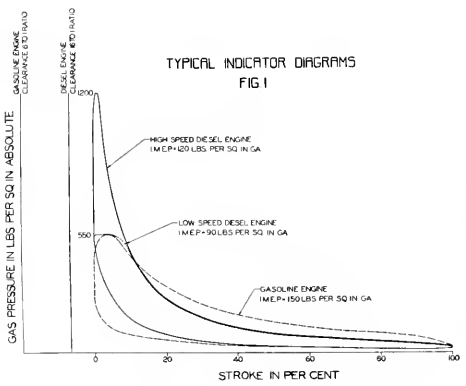
In recent years many attempts have been made to perfect small Diesels suitable for motor vehicle and aircraft work. In order to be thus used it is necessary that the weight be far below 100 lbs. per horsepower and that the speed be at least 1,000 r. p. m., in order that the Diesel may compare favorably with the Otto cycle engines at present used for these purposes.

To better understand why the Diesel is desirable and what difficulties are encountered in lightening it and speeding it up, it may be well to study briefly its principle of operation as compared with the Otto cycle engine.

For purposes of comparison let us follow through a four-stroke-cycle Otto engine and Diesel engine. Taking the Otto cycle first, we may begin with the suction stroke, during which the engine draws in a mixture of gasoline and air. The next stroke is the compression stroke, during which the mixture is compressed to about 80 lbs. per sq. in. When the piston is near the end of this stroke, an electric spark ignites the mixture. The resulting expansion of gases forces the piston down on its power stroke. The fourth stroke consists in the expulsion of the products of combustion.

The Diesel engine, on its suction stroke draws in pure air, which the piston compresses to about 550 lbs. per sq. in. on the next stroke. Near the end of the compression stroke, the fuel is injected into the air, which is at a very high temperature due to its compression. The fuel, upon striking this superheated air, ignites immediately and the expanding gases force the piston down on its power stroke. The fourth stroke is the exhaust, as before.

A graphic representation of these events is given in Fig. 1, which contains theoretical indicator cards of the Otto cycle engine and the low speed and high speed Diesel. An important distinction can be noted here. The card of the low speed Diesel tends to have a flat top which signifies that combustion takes place at constant pressure, giving the Diesel cycle its other name of "constant pressure cycle." The Otto cycle card, called the gasoline engine card, tends to come to a sharp top, signifying constant volume combustion, the Otto cycle being known as the "constant volume cycle."



Typical indicator diagram of the Diesel and Otto cycles.

From the previous considerations there is no particularly obvious reason why the Diesel engine should be heavier and slower than the Otto cycle engine. However, a further consideration of Fig. 1, will show that the indicated mean effective pressure of the Diesel is only 60 percent of that of the Otto engine. This is important, as it shows that the Diesel must be larger than the Otto engine for the same power and speed. The indicated mean effective pressure is that uniform pressure which may be considered to act on the piston throughout its power stroke, in other words, it is the average pressure as shown on the indicator card. It represents the work done per cubic inch of piston displacement and so is a measure of the relative sizes of two engines of equal power and speed. The one with the higher indicated mean effective pressure will be the smaller.

According to the cards shown, the Diesel would have to have about 65 percent more piston displacement than an equivalent Otto engine. This means a considerably larger engine and shows one reason why the Diesel has a high weight per horsepower. Since the Diesel runs at high pressures under all loads, the compression being constant, it must be built heavier and sturdier than the Otto engine which only operates at such pressures under heavy load and wide open throttle. Due to the energy needed to carry the Diesel over compression, it is usually equipped with a large and heavy flywheel, which adds still further to the weight.

The preceding discussion shows why the Diesel is heavier than the Otto engine of equal power and speed; it now remains to show the difficulties in the way of speeding up the engine.

It will be remembered that the fuel is injected in liquid form at about the end of the compression stroke. A study of the combustion reaction shows that it takes about six cubic feet of atmospheric air to burn one cubic inch of average fuel oil. The average airplane engine has a displacement of about 100 cubic inches per cylinder. A simple calculation shows that such a cylinder will use less than .01 cubic inch of fuel per cycle. The minuteness of this volume is better appreciated by considering it as a sphere about one-quarter of an inch in diameter. This drop of oil must be injected into the cylinder in a very small fraction of a second, a hundred times per minute, and against a pressure of 550 pounds per square inch. Nor is this all, for the injection pump must be easily regulated as to the quantity and time of injection, which correspond to the throttle and spark controls of the gasoline engine. The volume of fuel mentioned above is for full load operation, the volume for part load and idling being much less. Nor is it permissable to inject the fuel "any old way." It must be very finely

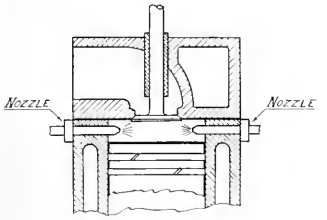


Fig. 3. Design of a typical pressure injection Diesel engine.

broken up in order that combustion shows that it takes about six cubic "any old way." It must be very finely may take place rapidly and completely. The cam operating the pump must have such a shape that the fuel is injected at the proper rate to give the flat top card, which is desired for low speed Diesels. The mechanical difficulties involved in speeding up this process without impairing its accuracy are obvious. Further, after the fuel is injected, it must be burned at the proper rate of speed so as not to produce detonation, on one hand, or delayed combustion and afterburning, on the other. The combustion process is hastened by thorough atomization of the fuel during injection and by having the combustion chamber so shaped as to give a high degree of turbulence to the air. This insures a thorough mixing of fuel and air and gives good combustion, but if the combustion is too rapid, it will take place with explosive violence, causing detonation, thereby imposing very heavy stresses on the engine.

Summarizing, a light weight high speed Diesel engine must have a high mean effective pressure, must be equipped with a fuel injection system capable of maintaining its accurate operation at high speeds, and must have an injection nozzle and combustion chamber which insure proper combustion.

It may be interesting at this time to show why the Diesel is desirable for automotive and aircraft work, thus explaining why so much time, money, and energy has been expended on the solution of the above mentioned problems.

The most commonly known advantage of the Diesel is its high fuel economy, an ordinary commercial Diesel having a higher overall efficiency than any other commercial prime mover. This feature makes it especially desirable for long distance aircraft work, where economy is of prime importance. For this class of service there are two other important advantages: the fire hazard is greatly reduced since nonvolatile fuel oil is used in place of highly volatile aviation gasoline, and the electrical system is totally eliminated, meaning that there is no radio interference and no possibility of engine stoppage due to the electrical system being short circuited during heavy rain storms.

For motor vehicle work the Diesel is superior by reason of its better torque characteristics, the torque, or pulling power, increasing as the speed decreases. This means that the Diesel is not so likely to stall under load and that the need for gear shifting is reduced. Other important practical considerations are the lower running costs, since cheap oil is used, and the absence of crankcase oil dilution, as the fuel is burned immediately on entering the cylinder and so cannot condense and drain past the pistons into the oil pump. This latter feature reduces maintenance expense, as the wearing parts will last longer when lubricated with uncontaminated oil. The Deisel, having an expansion ratio of about 14:1 as compared to 6:1 for a gasoline engine, will have a lower exhaust gas temperature, as the more the gases are expanded the lower their temperature becomes. This gives longer exhaust valve life, burning of the exhaust valves having always been a serious problem on high speed heavy duty gasoline engines. The Diesel, being more efficient than the Otto cycle engine, does not give

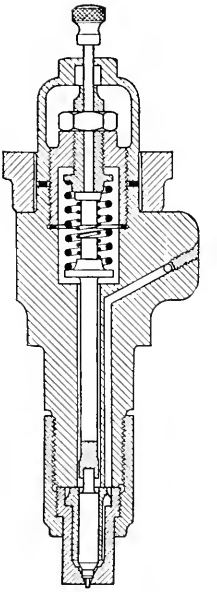


Fig 2. The Acro-Bosch injection valve.

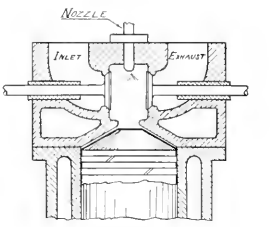


Fig. 4. Design of an antechamber type of Diesel engine.

up as much heat to the cooling medium, so that a water cooled Diesel requires a smaller radiator than a corresponding gasoline engine, and an air cooled Diesel can be more easily designed to maintain the proper operating temperature.

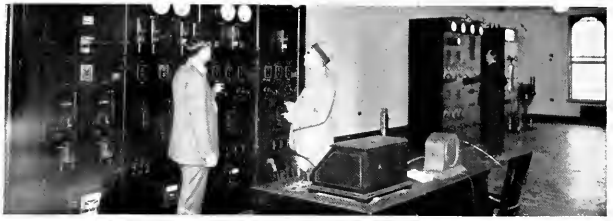
Although comprehensive figures as to the reliability of the light weight high speed Diesel are not yet available, it seems reasonable to suppose that it will be at least as reliable as the gasoline engine, and probably more so. A compilation of the causes of automobile breakdowns made over a period of four years shows that approximately 25 percent of all breakdowns are due to the carburetion and ignition systems. Of the engine breakdowns, over 50 percent are due to the carburetion and ignition systems. Since the Diesel has neither of these, but only an injection system, which is independent for each cylinder, it seems likely that the chances of breakdown will be considerably less.

In Europe, the high price of gasoline has been a strong incentive towards developing an engine that would run on cheap oil, and so there are quite a few different automobile and truck type Diesels being manufactured there. However, specific information is difficult to obtain and this article will be confined principally to work done in the United States.

The original Diesel engine injected the fuel by means of an air blast, but at present this method is losing ground in favor of the so-called solid injection system, in which the fuel is injected solely by hydraulic pressure, no air blast being used. This is the system mentioned in a previous paragraph and is the only one which will be considered, as all small high speed Diesels, with but one or two exceptions, employ solid injection.

There are several modifications of the solid injection system. In one type, which may be called the antechamber or precombustion chamber system, the fuel is injected into a chamber separated from the main combustion space by a more or less

(*Continued on page* 152)



Operator's control panel and monitoring speaker appear on the desk. In the background are the power supply panel, left, and the low-power radio frequency amplifier.

WENR—THE IN RADIO

By Harvey H. Dozois, '29
of Electrical

BROADCASTING station WENR, operated by the Great Lakes Broadcasting Company, is one of the largest and most modern radio stations of its kind in the world. It has a 50 kw. capacity and is now operating on that power output. Its programs are received over the entire country and in neighboring foreign countries with unusual volume. The mail from the fans in New Zealand is fairly heavy and reports the reception of the station's broadcasts in the early evening, at a time of day when daylight conditions exist over the shorter distance around the globe. It is assumed that the signals received have traveled in the west to east direction over a distance greater than half way around the world.

A great deal of time was spent in finding a suitable location for the station. It is on a 40-acre plot of land four miles south of Downers Grove, Ill. As the main object is to serve the listeners of the Chicago area, the location was chosen because it gave the most uniform reception throughout the city. In order to determine the location, a 1000 watt portable transmitter was set up in several test locations. A receiving station supplied with the necessary instruments was mounted in a truck and moved about from point to point in the city.

The studios and studio control room are located in the tower of the Straus Building located in Chicago's loop district. Four pairs of wires connect the studios to the transmitter station, 28 miles away. These are special high grade lines supplied by the Illinois Bell Telephone Company. Two of them follow the Ogden Avenue route to Downers Grove, thence south on Main Street to the station. The other two pair follow the Chicago-Omaha route along Joliet Road. This provision of two pairs of wires by different routes provides a dependable connection with the studio under practically all conditions. The condenser microphone, which is far superior to the carbon type, is being used in the studios.

The antenna towers are 300 feet high and are located 700 feet apart. These towers can be seen for many miles and are equipped with beacon lights as a warning to aviators. Each leg of the towers is mounted on four insulators, making it possible to operate with the towers either grounded or ungrounded. The antenna system consists of two vertical cables with a 35-foot horizontal section at the top located midway between the towers. The counterpoise or ground system consists of a series of bare copper

Replacing a 20-kilowatt water-cooled vacuum tube in the main modulator bank.

wires buried in the ground and extending radially out from the station for 300 feet.

Two outdoors substations are located at the southwest and southeast corners of the property. These substations are connected to two separate power stations of the Public Service Company system, giving a dependable power supply from 33,000 volt transmission lines. Each substation consists of a bank of 450 kva. transformers, which transform the energy from 33,000 volts to 2,300 volts. Underground cables conduct the 2,300 volt energy to the transmitter building, 900 feet away.

The transmitter building is erected in the center of the property, facing the Downers Grove-Lemont road. It is a two-story brick structure of attractive design, 65 feet in width, and 55 feet in depth. The main part of the building consists of a power room, 35 feet by 65 feet, on the main floor, and an operating room of the same size on the second floor. On the main floor are located the battery room,

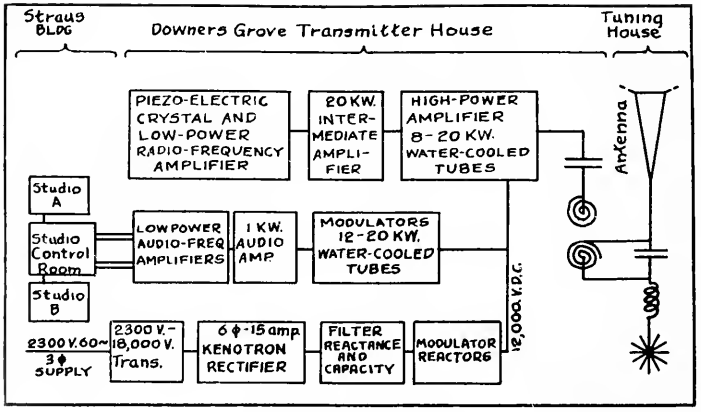


Diagram of the station layout.

Last Word Stations

Student in the Department Engineering

The three direct current generators, fitted with special commutators and brushes which furnish filament heating current for the tubes.

shop, pump room, tube vault and boiler room. The second floor provides space for an engineer's office, control room, dormitory, dinette, locker room and toilet facilities.

WENR, the Voice of Service.

The energy from the outdoor substation is fed through a voltage regulator to a bank of three 2300/18,000 volt transformers. These feed into a six-phase, 15 ampere kenotron rectifier, normally operated at about 12,000 volts. The rectifier is equipped with the necessary reactors and filters. To the north of this bank of transformers are several motor-generator sets used for plate supply in the crystal control circuit and amplifier and for bias voltages on the modulators and radio frequency amplifiers. About 1200 volts are used for biasing the amplifiers and approximately 400 volts are used to bias the grids of the modulators. Also in the power room are located three direct current generators fitted with special commutators and brushes to furnish filament heating current for the tubes. These tubes, of 20 kw. rating, require a filament current of 52 amperes at 22 volts. Two of these machines are used at a time, the total load being about 1600 amperes. The modulation reactors are also located in the power room. The battery room contains a 500 volt battery for use in conjunction with the audio amplifier equipment as well as filament batteries for the same.

The audio frequency signal is received over the telephone lines from the downtown studios. These terminate in the control room on the second floor. Here the audio frequency energy is amplified by several stages using 7½, 50 watt and finally the high-power audio amplifier which consists of a one-kilowatt tube. This feeds a bank of 14 20-kw. water cooled tubes. Several spare modulator tubes can be connected in case of trouble. A special oscillograph mounted on this control board enables the operator to measure the per cent of modulation. This varies from 40 to 70 per cent for this station.

The radio frequency oscillations originate in a seven and one-half watt tube, their frequency being controlled by a piezo-electric crystal. The temperature of the crystal is kept practically constant by a thermostat control mounted in the case with it. This is a further precaution toward keeping the frequency constant. The radio frequency oscillations are then carried through a low power amplifier consisting of another seven and one-half watt tube, a 50 watt and a 100 watt circuit to an intermediate amplifier consisting of one 20-kw. tube and finally to the high power radio-frequency amplifier which contains eight 20-kw. water-cooled tubes connected in push-pull circuit.

The output of this amplifier is trans-

(*Continued on page* 156)

General view of the main operating room. Along the left wall are the high-power radio frequency amplifiers, and the modulators, equipped with 20-kilowatt water-cooled tubes. Behind the operator's desk is the kenotron rectifier. On the right are the power supply panel, crystal control panel, and intermediate radio frequency amplifier.

Fire Hazards in Fuel Storage

By R. E. Kilbourne, '30

Student in the Department of Fire Protection Engineering

THE storage of coal in large quantities is absolutely necessary for several economic reasons, and this storage of coal, especially bituminous coal, is attended under certain conditions by considerable tendency to spontaneous ignition.

Provision for the storage of coal is necessary to help in the stabilization of an industry of fundamental importance by permitting mining operations to proceed throughout the year at a fairly uniform rate. It also serves in a large measure as insurance against the losses accompanying a shortage to the fuel consuming industries.

If coal is stored during the summer months railroads can move a part of the tonnage during that season. At present they are called upon to move the entire tonnage in about two months of each fall and early winter, at which period no railroad in the country has the power and cars to move the coal according to demand.

The reasons for storing coal may be listed as follows:

1. To assure the consumer an adequate supply which protects him against strikes, labor disturbances, and uncertain railroad deliveries.
2. To take advantage of water transportation and low freight rates.
3. To secure the advantages of low prices.
4. To equalize the prices on the different sizes of coal.
5. To avoid the maintenance by the railroads of equipment which is used for only part of the year.
6. To maintain a uniform rate of production at the mines.

Storage piles are usually in the form of truncated cones, or pyramids, the size depending mainly upon the appliances used in storing and reclaiming, and upon the space available.

The greatest difficulty in the storage of coal is undoubtedly the tendency of many coals to fire spontaneously, and it is the deterioration due to this cause which is often confused with a supposed decrease of heating value as a result of storage.

The gradual heating of a coal pile is due mainly to slow oxidation of the carbon in the coal, and to a less extent to the oxidation of the sulphur in the iron pyrites contained in the coal. If the air supply is sufficient to permit oxidation but not sufficient to carry away the heat as rapidly as it is formed, the temperature in the pile will rise gradually and finally the coal will fire. Any method of storage to be successful must be so designed that the heat generated in the pile will not exceed the heat lost by radiation. Freshly mined coal has a special tendency to oxidize and thus to heat. While this property varies with the different varieties of coal, it is generally true of all coals. The greater the time elapsing between the mining and storing of any coal, the less is the liability to firing; hence, if possible, coal should be exposed to the air, that is, allowed to become seasoned before it is put in storage. This is, of course, often impracticable.

Oxidation of both the carbon and the sulphur takes place more rapidly as the temperature increases; hence coal stored during hot weather is more likely to heat than that stored on cool days. In spite of this fact, however, many prefer to store coal during July and August, not only because of the lower price which usually prevails during these months, but because, as they say, "the coal is drier and less apt to fire."

The smaller the coal the greater is the surface area exposed to the air, the more rapid is the oxidation and the greater the tendency to heat; hence coal in lumps is not so likely to fire as fine coal, slack, or run of mine coal. If possible, the slack should be removed before storing. Care should be taken in handling the coal to minimize the breakage. In handling large quantities of coal this precaution cannot be given the same attention as when handling small quantities, but whenever it is impossible to screen the coal before storing and whenever sizes and kinds must be mixed, means should be provided to open the pile rapidly, since heating may then be expected. Many persons believe that washed coal will not fire as readily as unwashed because the dust has been removed.

Air currents through a pile, unless ample to carry off the heat, should be avoided since many fires seem to be due to sluggish air currents in contact with fine coal. Coal should, when possible, be piled to avoid alternate stratification of coarse and fine coal.

The opinion is wide-spread that a mixture of different varieties of coals is more liable to spontaneous combustion than a pile of a single kind. While no explanation of this opinion has been given it is possible that the most easily combustible coal in a pile merely starts the heating and thus lowers the safety point of the less combustible coal. J. B. Porter says: "With reference to the prevailing opinion that a pile of mixed coal is more liable to heat than one of uniform material—I can only say that my observations, so far as they go, bear out this opinion, but do not throw any clear light on the case. I can see no reason why a mixture of coals should be any worse than the worst coal in the lot, and I think it quite likely that this will prove to be true. There are, however, so many authenticated cases of mixed coals heating when apparently either of them would have kept safely by itself that I think we should keep on the safe side by avoiding mixtures whenever possible. I may add that the objection to mixtures is by no means confined to this continent; in fact, if my memory serves me, the danger of coal mixtures was first pointed out in England, and I believe in connection with East Yorkshire coals."

The high percentage of volatile matter in coal does not of itself increase its liability to spontaneous combustion. As a result of 1,200 replies received from large consumers of coal, Porter and Ovitz concluded that there is no reason to place special confidence in smokeless coals for safety in storage. The large stock piles at Panama, with seventeen to twenty-one per cent of volatile matter, give a great deal of trouble from spontaneous fires. Several large works report, however, that their low-volatile coals are more troublesome with respect to spontaneous fires than their high-volatile gas coals.

The high-volatile coals of the West are usually very liable to spontaneous heating, but owe this property to the chemical nature of their constituent substances rather than to the amount of volatile matter in them. Strange as it may seem, the oxygen content of coal appears to bear a direct relation to the avidity with which coal absorbs oxygen; high oxygen coals absorb oxygen readily, and therefore, have a

marked tendency to spontaneous combustion.

Formerly the gradual heating of the coal and its final spontaneous ignition was thought to be entirely or partially due to the presence of sulphur. The chemical studies of Parr, Ovitz, Porter, and others, have shown that a coal may heat as a result of the oxidation of the carbon, even when pyritic sulphur is absent. If pyritic sulphur is present, oxidation of this sulphur takes place, thereby supplying a definite additional source of heat and assisting in the oxidation of the carbon. The oxidation of the sulphur also acts mechanically to break up the coal; thus increasing the amount of small coal, and the tendency to fire.

Although sulphur has been shown to be only one of the factors producing heat, it is still thought, by many who store coal, to be the determining element in the heating of coal.

Near Danville, Illinois, the Missionfield Mining Company has a plant for separating pyrite from the coal and preparing the pyrite for market. According to the superintendent of the plant, even the fine pyrite passing through a $\frac{7}{16}$ inch screen has never fired in the bin, except when there has been found in the pile a piece of wood, or other carbonaceous substance, which has acted as a match to start the combustion.

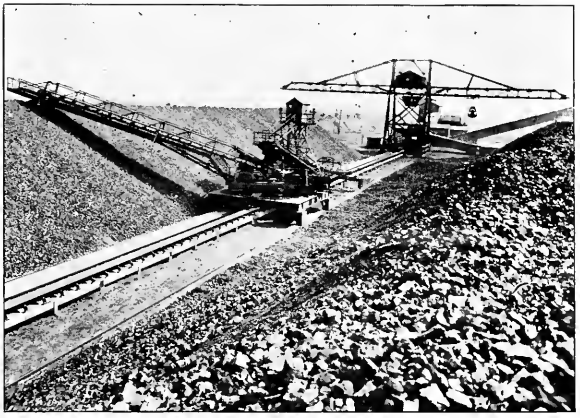
In spite of the results of tests, the opinion prevails very generally that a high sulphur coal is more likely to fire than one containing a small amount of pyrite, and an investigation should be undertaken to show the exact influence. It has been suggested that the pyrite may oxidize and set the sulphur free according to the reaction and that the

$$FeS_2+2O_2=FeSO_4+S$$

free sulphur having a low ignition point may act as an igniter as it does in a match or in gunpowder. It is certainly true that on many weathered coal dumps there is a deposit of yellowish white material which very closely resemble free sulphur.

The effect of moisture upon the heating of coal is a much disputed question, although those who store coal are practically unanimous in the opinion that water stimulates spontaneous combustion. On the other hand, scientific investigations seem to indicate that coal oxidizes less when wet than when dry. The effect of water in disintegrating coal high in sulphur is undoubted. Vivian Lewes, of England, draws a sharp distinction between wet coal and damp coal, the latter being considered dangerous. The undoubted fact that the top of a coal pile is warm after a rain is explained by the New South Wales Commission as due, not to the fact that the water causes the coal to heat, but the pile being already hot inside heats the water which runs down into the pile and then returns as steam to the surface and heats it.

Coal immersed in water does not deteriorate to any extent chemically nor does it disintegrate except as a result of handling. The amount of water absorbed does not affect the burning qualities of the coal.



The storge coal supply of a typical large central station. This pile is protected by thermometers inserted at intervals throughout its length.

Instances in which water seemed to assist in stimulating spontaneous combustion are quoted in connection with reports regarding coal stored by railroads. A pile is reported to have fired under conditions in which seepage from the water tank kept part of the pile damp. Another instance occurred in a low corner of a coal pile where water collected, but this corner was shut in by a side hill which excluded the air so that it is a question which agency caused the fire, the presence of the water or an insufficient amount of air.

There is a wide diversity of opinion concerning the height of piles, and many think that piles should not be more than ten feet high.

Coal is seldom piled, at present, more than fifty feet high, but it has been successfully stored in piles varying in height from six to sixty feet and it has also frequently fired in very low piles. The depth is not so important as the manner in which the coal is placed in storage and the facilities available for quickly removing it in case of a fire.

The following statement by F. W. Gray is of interest with regard to the effects of the temperature at which coal is placed in storage: "The most extensive storage yet undertaken was in the winter months of 1913-1914, when 650,000 tons of coal were 'banked' by the Dominion Coal Company at their Glace Bay mines. The coal is lifted in the summer by steam shovels, rescreened and shipped. There has never yet been an actual fire in the round coal banks, although the first coal banked out must remain in the center of the pile for over six months before it is lifted. Heating sometimes takes place, but with proper methods this can be speedily checked and dissipated. The temperature of the air, at the actual time of banking, is an important consideration, as generally speaking the banked coal seems to remain at about the temperature which it had when placed in the bank. The bulk of the coal placed on the ground is, of course, put there in cold or freezing weather. If a thermometer is lowered down a pipe into the interior of the bank it will usually register a temperature near to the freezing point, a fact that is interesting to observe on a hot summer day, when the surface of the banked coal is quite warm to the hand. The coal is banked up to a height of from 40 to 46 feet, and over 300,000 tons have been stored in a continuous pile."

There is the greatest danger when coal is stored during the hot months, July and August, and the liability is greatly reduced if it is stored in May, June, September, or October.

An examination of piles which have fired shows that the fires have started frequently near the top and sides and not at any great depth in the pile. A current of air in the pile, too sluggish to carry off the heat, a piece of wood, or oily waste, may furnish a starting place for fire. The theory has been advanced that the temperature of a current of air rising through a pile of coal in which oxidation is taking place receives sufficient heat from the oxidizing coal to increase the tendency to spontaneous combustion near the top.

One objection to high piles lies in the difficulty of testing for heating. Low piles are advantageous because

(*Continued on page* 158)

ENGINEERING NEWS

New Developments in Hydrogen Welding

The apparatus used in this new method of atomic-hydrogen welding consists simply of a support to hold the tungsten electrodes and two tubes directing a hydrogen flame around them. It is entirely an electric arc, as the energy is all electrical, the hydrogen serving only to protect the electrodes and metal from oxidation.

The replacing of air with hydrogen has made the indirect arc welding process successful. It is adaptable to the welding of thin materials. It has made possible the welding of special alloys and those with low melting points This is possible because the electrodes are non-consuming and the material can be added to the welded plate from a special welding rod of any desired composition. If this was attempted with a direct arc it would be found that if the electrode has high chromium or carbon, it is almost impossible to maintain an arc. The welding of metals with low melting points is possible because the temperature of the indirect arc can easily be maintained below the vaporizing temperature of the metal.

The formation of aluminum oxide is the greatest obstacle to the welding of aluminum. The atomic hydrogen welding prevents this formation and is therefore of great value for this work. However, it is not as yet possible to weld thin sheets of aluminum without the use of fluxes.

Water-Cooled Electrode Holder

A new type of carbon electrode holder weighing three and a quarter pounds has been developed for heavy duty welding. It is water cooled, and insures greater comfort for the operator. The carbon holder consists of a coiled copper tube through which the water circulates. The electrode is inserted through the tubing. At the front of the holder is a magnesium plate to protect the operator's hands from the arc rays. The cables running to the electrodes are placed within the hose line, the water acting also as a cooling agent for the cable.

New York City's New Municipal Airport

The Floyd Bennett Field, located on Barren Island in Jamaica Bay about twelve miles east of the Pennsylvania Station and now in the process of construction, is New York's first attempt at a municipal airport. As now planned, hangar space for about one hundred planes and parking space for about three thousand automobiles will be provided. Two fifty-foot concrete runways for take-off purposes only are to be provided. One is 3,110 feet long and runs southeast and northwest; the other is 4,000 feet long and is directed northeast.

The top grade of the 387 acre field is to be built on sand pumped in from the bay and will be sixteen feet above the mean low water level. Six million cubic yards of sand have been filled in so far. A layer of subsoil with a good clay mixture will be topped with a soil suitable for growth of a thick grass. A hedge on the northwest side is being planted to check the drifting in of sand from this direction.

Seaplanes will be accommodated in the Jamaica Bay channel in a paved bulkhead area four hundred feet by eight hundred feet, including forty-eight thousand square feet of hangar space. Special ticket offices, waiting room, etc., are to be provided. In order that seaplanes that do not wish to come up to the hangar may discharge passengers there is a twelve hundred foot beach north of the bulkhead area. A concrete ramp one hundred feet wide and extending five feet below the surface of the water is included in the plans, to assist seaplanes and amphibians in entering and leaving the water.

It is expected that this initial construction will be completed some time in 1930.

Counting Traffic Electrically

In the Holland Tunnel, which carries New York-New Jersey vehicular traffic, has been installed an experimental unit for electrically counting traffic. The apparatus includes a small floodlight mounted in an inclined position upon the overhead ironwork of the tunnel. The fine beam of light falls upon a circular window in a box mounted on the opposite side of the roadway. In this box is a photo-electric cell, an amplifier, and an electrical relay. Every interruption of the beam of light by a passing vehicle is translated by the receiving device into an electrical impulse, which actuates the relay. This latter is connected in a transmission circuit connected to the administration building. There a registering meter is connected and the number of actions of the relay recorded.

It is planned to install this equipment in several sections of the two traffic tubes so that the volume of traffic at each point may be determined readily. This system will assist greatly in the regulation of ventilation and in the quick location of traffic tie-ups and accidents.

Stainless Steel

At the present time there is much technical research in the phenomena of corrosion, and various theories, such as passivity produced by an oxide film, passivity due to a gaseous film of oxygen, and the acid and electrolytic theories, have been propounded. Whatever the theory, it is known that certain materials are more resistant to attack than others. Such a material is stainless steel.

It is a fact, not commonly known, that iron is soluble in water. Brearly discovered that chromium renders iron insoluble in water and in many other acid and alkali solutions. When iron is combined with carbon in the form of steel it not only is soluble but corrodes more rapidly because of galvanic action between iron and carbides of iron.

With the knowledge, therefore, that certain percentages of chromium in combination with iron render the resultant iron-chromium compound insoluble in water and in other solutions, and that carbides present in such alloys with less than sixteen percent chromium can be dissolved in the iron-chromium matrix by heat treatment,

a corrosion resistant alloy can be produced, which by homogeneity removes any possibility of galvanic action and which is insoluble in water.

An analysis of a typical stainless steel shows a composition of 0.37 percent carbon, 0.15 percent manganese, 0.19 percent silicon, 12.00 percent chromium, 0.55 percent nickel, and 86.74 percent iron. Such an alloy air-hardened from 1700 degrees Fahrenheit and reheated to 900 degrees would have an ultimate strength of about 230,000 pounds per square inch, with an elastic limit of half this amount.

The Work That Brakes Do

When a car moving at 75 miles per hour is brought to a halt by braking, a great deal of heat, probably the equivalent of between 3,000,000 and 5,000,000 foot-pounds, must be dissipated. The brake-drum temperature, under such circumstances, often rises momentarily to approximately 2000 degrees Fahrenheit and the necessity of rapidly dissipating this heat must hereafter be given more attention than it has received in the past, says William G. Wall, past-president of the S. A. E.

The improvement made in brakes in recent years has made faster automobiles possible, and increased decelerating, or stopping, ability has been gained by using larger brake drums and larger braking surfaces, according to Mr. Wall.

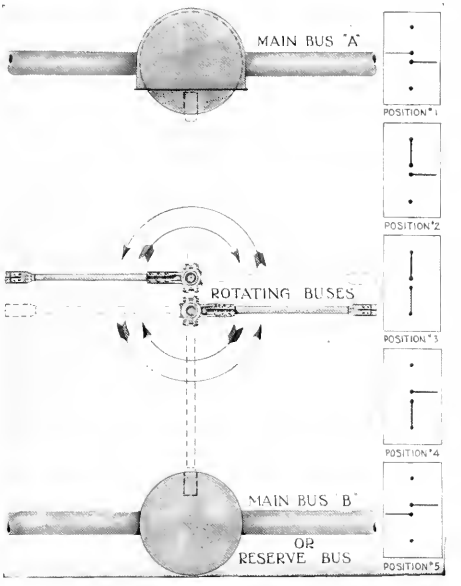
When a car that travels at high speed is being stopped, the brake effectiveness often is found to be diminishing during the last part of the deceleration, because the brake drum is expanding. With car weight tending to increase, braking ability must of course be increased.

(From the Journal of the Society of Automotive Engineers)

A New Transatlantic Cable

The Western Union Telegraph Company recently opened to public service a two million dollar cable between Newfoundland and the Azores, by means of which New York may be directly connected to Germany, Spain, Italy, and Africa. Simultaneous sending and receiving with four messages being transmitted in each direction is the operating capacity of this newest link. This has been made possible largely by the use of a new alloy of nickel, cobalt, and iron, called mumetal, which is used in both sheath and core.

This 1550 mile submarine cable is divided into five sections, the main deep-sea section containing 280 pounds of copper, 60 pounds of mumetal, and 225 pounds of gutta-percha per nautical mile. This central section is covered throughout its length with five spirally wound copper strips on which is laid a close wrapping of fine mumetal wire. The adjoining sections, seventy miles in length, have a core containing 325 pounds of copper, 50 pounds of mumetal, and 270 pounds of gutta-percha per mile. The end sections, of 160 miles each, have five hundred pounds of copper and three hundred pounds of gutta-percha in every mile. This cable has several times the capacity of existing cables.



Rotating Buses Simplify Outdoor Substation Design

By the use of rotary buses, in outdoor substations, it has been found that the number of insulators required is reduced by 50 per cent, the construction is simplified, and ground space is saved.

Instead of running connections from two buses to a set of bus selector switches mounted elsewhere on the steel structure, these switches are so designed and placed that in themselves they form the tap-off connections from buses to the disconnecting switches for the oil circuit breakers. The stationary contacts for the disconnecting switches are mounted on the buses themselves. There are two rotating buses for each phase, one supporting blades for the upper main bus, the lower blades for the lower main bus. The two buses of the same potential are supported on insulator stacks which serve also as operating means for the selector switches. The parallel rotating buses move the disconnecting switch blades clamped to them through an arc of 180 degrees in one complete operating cycle. The next cycle carries the blades back to their original positions. The blades do not rotate simultaneously, but alternately, so that the blade movement sequences are as shown in the above diagrams, positions one, two, three, four, and five.

A change in connection from main bus "A" to main bus "B" must include the temporary paralleling of these main buses when unit control is used. The scheme may be applied with separate controls of each rotating bus, in which case there is no relation between their movements and the device becomes simply a pair of disconnecting switches with their blades electrically connected together.

Lamp Deposit Remover

The development of a practical method of removing the black deposit that gradually collects on the inner surface of high-powered incandescent lamps has been announced by the lamp department of the General Electric Company.

The deposit-remover is a tablespoonful of coarse tungsten powder placed inside the lamp before it is sealed. After the lamp has become blackened the operator need only to "sweep" the deposit off by allowing the powder to slide over it. The result is a better lamp efficiency due to the fact that the filament can be heated nearer to its melting point without shortening the life of the lamp.

Automatic Train Control Apparatus

Railroad history includes several examples where the engineer has failed to control his train, due to physical disability and sometimes even to sudden death, resulting in serious losses of life and property. In an effort to remove this menacing human element from the operation, numerous automatic control devices have been tried and have usually proven faulty.

The New York Central Railroad has succeeded in obtaining a device which answers all the needs. It consists of two parts: a "receiver" which is attached to the journal box on the tender, and consists of an inverted U-

(*Continued on page* 162)

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering
ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XX **May, 1929** **No. 4**

Make The Armour Engineer the best technical college publication in the country.

It is in the interest of those with whom I converse that I should read beautiful books.

—Madame Sevigne.

THE ALLOY AGE. That an Alloy Age would come, following the Ages of Stone, Copper, Bronze, and Iron, has been a logical prediction for some time, but possibly no single event has so strongly threatened to tip the world of industry in its direction as the discovery of the new cobalt-carbon-tungsten alloy Carboloy.

A cutting edge is a commonplace thing—too common, perhaps, to be appreciated by most of us. Yet it is literally man's most valuable material asset. If one inclines to doubt this broad claim let him imagine a world suddenly robbed of cutting edges. To make the things he requires, man would have ten fingers, those few pieces of wood which nature happened to leave in ready broken form, and stones capable of being used for crushing. A million years of cultural evolution would have been lost. In the last analysis, then, human advance above the ape stage has been almost contingent on the ability to shape things, and this demands cutting edges harder than the things to be shaped.

How futile is the assumption occasionally made that we have at last reached the summit of perfection in cutting edges or anything, has already been made manifest by the recent discovery. Even if the new, almost diamond-hard alloy cost as much as ten times its weight in gold it would be worth the price if it provided a cutting edge which would enable one workman to turn out two pieces of work where he turns out one today.

ATHLETICS. While the Armour Institute of Technology does not depend upon its athletic renown to attract prospective students, Armour teams have always been of a high caliber. Teams of large universities may have great names and reputations, but is the true purpose of school athletics any better served at such schools than at our own?

College athletics can be brought under two headings — intermural, and intercollegiate. The intermural branch is the older of the two and years ago was, by far, the most important. Intercollegiate competition, however, has now assumed a greater significance and today is on the crest of its glory. Massive stadiums and immense crowds have just about put college athletics on a commercial basis. As all these things grow, the actual student body participates less and less in the games. One critic writes: "The real value of an athletic contest may be measured by a fraction whose numerator is the number of players, and whose denominator is the number of watchers, present or absent. As the latter increases the game degenerates into a sport, the sport into a spectacle, and the spectacle into a gambling device."

Athletic games are primarily to provide exercise for the students, to develop physically their bodies, and to afford a means of recreation. The large number of students at these schools, and the caliber of their teams discourage many men of mediocre ability from even trying out. At Armour, any man with a lot of determination and a small amount of skill can make good on almost any team.

Minor sports are especially important in school athletics, more so than the major ones. After graduation how many fellows will continue to play basketball or baseball? Golf, swimming, and tennis are sports that an individual can enjoy for the rest of his life. Resolve to come out for one of the varsity teams next year.

KNOW THYSELF. During our four years at Armour we have come in contact with the tools of engineering and have found that mathematics, physics, chemistry, and economics are the basic studies underlying engineering. We are able to use these tools, or at least should be able, and know how to find information on practically every engineering subject. But when asked what engineering is and what qualities an engineer should possess most of us are not quite certain what to answer.

Our old friend, Dean Monin, has given a definition of engineering that is very good, and is easy to remember. Here is the definition: "Engineering is the science of controlling the forces and utilizing the materials of nature for the benefit of man, and the art of organizing and directing human activities therewith." Professor Wilcox comes forward with the statement that an engineer is a scientist with the view of practical application. By reading the current publications in the library we find that an engineer should possess three qualities in order to be a success in engineering. First, an engineer should have a good supply of common sense to use the information that is acquired in school and in the technical publications. Second, he should be able and be willing to do hard and disagreeable work. And last, he should have a congenial nature and an adaptibility for working with men.

Surely if the two definitions and three qualifications are placed in our notebook or in the files of our brain there will be no need to hem and haw at some inopportune time.

THE ECONOMIC URGE. Few people realize the advantages in the economic urge. Everybody in the United States is looking for a job or is working. The job seems to be the supreme thing among us, and the man who hasn't anything to do is not considered of much account.

Some people regard this as materialistic, as not being conducive to the virtues of the higher life, such as art, education and religion, but it will be found that the economic argument is the very best for the invisible qualities.

It is usual to sneer at people who become religious because they want to get on in the world and want to be prosperous, but after all the Ten Commandments are the foundation of world prosperity. A man will get along better and have more earthly success if he obeys the Golden Rule than if he looks out constantly for Number One, regardless of other people.

It is a great thing for religion, to find out that religion pays in this life. You don't have to wait for the next life, you don't have to spend all your time here in misery and failure in the hope of future reward. The economic urge has got behind religion and it is one of the best things that ever happened to it.

World-wide prohibition is an economic necessity. Prohibition has rendered the United States so prosperous that the drink-cursed nations realize they cannot compete with us until they get upon the same basis.

Never has any country prospered materially so much as the United States since the passage of the Prohibition Amendment. The economic urge is behind the abolition of liquor. We have found out that the drink habit interferes with prosperity, and the economic urge says that whatever interferes with prosperity must go.

In a country ruled by ideas of economic efficiency, education is found to be a necessity. When the people are educated their wants are more, their manner of living is higher and better, and hence they buy more goods. Young people are more and more seeing that it is the educated man or the trained man or woman who prospers in this life. Education and prosperity go hand in hand.

It will be found that in a world governed by business ideals the spiritual virtues have a better chance than in a world governed by a monarchial idea.

On the whole, men and women are better citizens if they are inspired with the desire to make a living for themselves rather than if all the reason they have for living is to serve their country or be good soldiers for a king.—*Adapted from Dr. Frank Crane.*

THE TEST

The test of a man is the fight he makes,
The grit that he daily shows,
The way he stands on his feet and takes
Fate's numerous bumps and blows.
A coward can smile when there's nought to fear,
When nothing his progress bars.
But it takes a man to stand up and cheer,
When some other fellow stars.

It isn't the victory, after all,
But the fight that a brother makes.
The man, who, driven against the wall,
Still stands up erect and takes
The blows of fate with his head held high,
Bleeding and bruised and pale,
Is the man who'll win in the bye and bye,
For he isn't afraid to fail.

It's the bumps you get and the blows you take,
And the shocks that your courage stands,
The hours of sorrow and vain regret,
That prize that escapes your hands,
That test your mettle and prove your worth,
It isn't the blows you deal,
But the blows that you take on this good old earth
That show if your stuff is real.

—*Anonymous.*

VACATION. Our dictionary gives as one of the definitions of vacation: freedom from interruption, trouble, or perplexity. It is hoped that this vacation will mean just that to all of us. It is only after a hard day's work that a man enjoys his night's rest, only after a hard fought round that the boxer appreciates his brief minute rest, and only after a term of hard studying that a student can appreciate summer vacation. To really enjoy the pleasant things in life we must have our share of the unpleasant.

When, immediately after the school term ends, a fellow experiences the sudden change from the rust and cramming of final examinations and the bustle of finishing neglected school work, to rest and relaxation twenty-four hours a day, it seems rather nice but for a steady diet he soon tires of it and feels the need for some sort of occupation. An active mind stagnates at such an unnatural condition, and seeks a state in which work and rest balance.

As we rush through school, some of us don't have the time, or take the time, to stop and think and consider what it all means. We are so busy absorbing facts and formulae that the significance and the meaning of it all does not penetrate. Vacation time is a breathing space placed in the educational period to allow the student to get a clearer idea of things, to catch up with himself, and to realize the logic behind it all.

EDUCATION, BY THE WAYSIDE. To be "educated" means to know the world; and that does not mean world-wide travel nor absence from one's job or business; it simply means that one shall really fasten his attention on the country about his own home, look at things instead of looking away from them, and train himself to notice carefully signs and forms and movements of life which he sees every day, but which may be really unobserved.

A man is fortunate if he can give up his youth entirely to the business of getting an education, but no man need remain uneducated because he is compelled to go to work while others are at school or college. There is no excuse today for the ignorant man; the man who can use his eyes and his ears and can ask questions, and remains ignorant, no matter what his job may be remains ignorant by choice, not by necessity. No man need leave his work for one hour in order to gain an education; he can educate himself while he works. This is precisely what a great many of the best men have done. The story of American business and industry is full of examples of boys and men who have turned a working life into a continuous school and have passed from grade to grade in this school, not only with widening knowledge, but also with steadily increasing efficiency in their various trades and occupations.

These men can be picked out of the crowd of workers who throng all the fields of labor because of their skill, their interest in what they are doing, their agreeableness, their interesting conversation and their contentment. They do not make the blunder of supposing that their condition in life, their success or failure, are decided by other people; they have resolutely taken to heart the great, decisive truth that while conditions have much to do with the choice of tools and a vocation, each man determines for himself how large or how small a man he will be and how important or unimportant he will make himself to his employer, or in his vocation.

If men were more intent upon making themselves masters of their work and less intent on getting the most they can in the way of wages, while giving the least they can in the way of labor and devotion, there would be a great addition to the ranks of those workers who are both successful and happy. The man who works simply for the wage at the end of the week, and only does what is necessary to get it, keeps himself down. The man who, in skill and devotion, is always ahead of the demands of his work, is on the highway to independence. He who would succeed must not only work, but educate himself as he works.

—*Adapted from "Success."*

To complete its files the New York Public Library is in need of the following numbers of the Armour Engineer:

Vols. I, II and III, Nos. 2, 3, and 4; Vol. IV, Nos. 3 and 4; Vol. X, No. 1; and Vol. XIV, No. 1.

If any reader has any of these numbers that he no longer needs, the Library and the Engineer would greatly appreciate his sending them to the New York Library or to the office of the Armour Engineer.

College Notes

Trognitz Places in A. A. F. Meet

At a swimming meet held Saturday, March 16th, at the Lincoln Turner Hall, Walter Trognitz, '30, captain of the swimming team, forced Van Tyne, National Amateur Champion, to break the A. A. F. record for the 200 yard breast stroke in order to beat him. Van Tyne's time was 2:46 while Trognitz was second with 2:51. Trognitz led at the 100 yard mark but lost in the last hundred yards in a thrilling sprint.

At a meeting of the swimming team held Thursday, April 11th, Fred Strauch, '30, Architect, was elected to the captaincy for the coming year. Strauch has won two minor letters in swimming since competing under the Armour colors. He has been a consistent point winner in the events he has entered and will be a mainstay of the team next year.

W. N. Alderman, '30, Department of Architecture, won the Scarab Fraternity Prize for the best drawing submitted for the Scarab Annual Sketch Exhibit. His drawing was adjudged the best of 150 submitted by members of the ten temples.

The purpose of the exhibit is to encourage more sketching in the various mediums and to promote comparisons of work done along these lines at the various schools. Anyone studying architecture at a school where there is a temple of Scarab is eligible to have his sketches shown in the exhibit.

Beverly Dudley, '30, recently left Armour to take a position on the staff of QST, the official magazine of the American Radio Relay League, with headquarters at Hartford, Connecticut. He will have charge of the Experimenter's Section and the Technical Information Service Desk. His work will consist largely of correspondence with practical amateurs who want information on any subject closely or remotely connected with radio.

Dudley has done this kind of work before, having written for the Radio Section of the Post, besides answering all of the questions which that newspaper received concerning radio.

The boxing team's 1928-29 campaign came to a close Monday, April 1. N. D. Buehling, '30, has been elected to the captaincy of next year's team.

This year's boxing program has by far been the most successful ever existing at Armour. The team has had five matches involving thirty-eight fights. Twelve of these battles were won and one came to a draw. In comparing this year's results with those of other years, it can readily be seen that Armour's 1928-29 team is decidedly improved.

OUR VARSITY CAPTAINS

Baseball

Abel Gent, '29

The pilot of Armour's baseball team of this season is Abel Gent, a senior in the department of fire protection engineering. He was born on June 23, 1907. Baseball has formed his chief athletic activity during all his school years, but he has been an ardent supporter of basketball and other sports. While at Carl Schurz High School he was a member of the baseball squad but was not on the team. Since his enrollment at Armour he has played on the varsity team, this being his fourth year. During his sophomore year he received his letter in that sport. His conscientious and untiring work has won him his present position as captain.

"Abe's" activities have not been all along athletic lines, however. He is a member of Phi Pi Phi social fraternity. This year he was appointed a member of the senior social committee. He has also been active in the musical organizations, having sung several times with "Stresses and Strains." This disproves the saying that athletes are not good at anything else.

These varied activities show his versatility, and together with his personality, explain his popularity among the students. His pleasant disposition and friendly smile have won him many friends among the persons with whom he comes in contact. Although his activities with baseball require a great deal of time, he maintains his scholastic average well above the "danger line."

Simpson Elected Basketball Captain

At a meeting of the basketball squad W. King Simpson, '30, was elected for the 1929-30 season. The captain-elect has already won two letters in baseball and two in basketball. In the season just finished King led the Armour cagers in scoring with 86 points. He has a deadly eye for the basket, and his floor work would delight any coach. Much can be expected of the team with Simpson as its leader in the coming cage campaign.

The following members of last season's team were awarded letters: Major—Capt. Manz, A. Augustine, S. Goodheart, W. Simpson, H. Rossing; Minor—C. Robin, S. Ott.

The annual Inter-Honorary Council dance was held April 19th at the St. Clair Hotel. Music was furnished by the "Doctors of Syncopation" orchestra. A professional dancer was engaged by the committee to entertain the guests, and last, but not least, the pledges of all the honorary fraternities demonstrated how the Armour "Fight Song" should be sung amid a shower of pennies from a strangely unappreciative audience.

Athletic Association Selects Ten Honor Men

Following the custom inaugurated by the Cycle staff in 1928 of printing a gold-numbered Honor edition of the year book and awarding it to ten of the most outstanding men of the graduating class, ten seniors have been selected to receive this year's awards. The men chosen are: Christiansen, Stellar, Rezac, Manz, Yount, Lamb, Bernhard, Gent, Augustine, and Hommes.

The aim in offering this annual award is to create an enthusiasm for a well rounded education for the student at Armour, namely good scholarship and a fair amount of participation in school affairs. Such a man is valuable to the school, and at the same time he reaps huge benefits from such participation.

With a crowd of over two hundred couples attending, the Freshman Dance was held at the Opera Club, Friday evening, April 12th. The music was furnished by Waddy Wadsworth and his orchestra. A feature of the evening was a surprise dance put on by Ed Craig and his partner.

The Junior Prom was held this year in the Balloon Room of the Congress Hotel, on May 17. Following the custom set by the present senior class, the affair was a supper dance.

Other events scheduled for Junior Week were Open House, May 13, the Home Concert of the Musical Clubs, May 15, and Circus Day, May 18. The events of this week closed the social season for the college year.

The Senior Chemical Class, under the direction of Professor McCormack, is undertaking for the first time in the history of the chemical department semi-research work on special subjects. The subject of the investigation is selected by the student in some cases, and in others it is assigned to him. The investigations under way at the present time include experiments with Bakelite, the development of hydraulic presses for the extraction of peanut oil, the vulcanization of rubber, the development of silica gel, and the classification of crankcase oil.

The Sigma Kappa Delta fraternity, on March 16, moved from their former home at 3361 S. Michigan to larger and finer quarters at 3344 S. Michigan. Their new home was built by Philip D. Armour, and presented to his daughter on her marriage. The new home, with its large rooms, many fireplaces and luxurious furnishings, is one of the largest and finest on the campus.

ALUMNI NEWS

The Armour Northwestern Merger

The Trustees of Northwestern University and Armour Institute of Technology announce that the proposed affiliation of the Institute with Northwestern has been abandoned with the consent and approval of both parties. This decision has been reached only after mature consideration, and the proposed affiliation abandoned for what are thought to be the best interests of both institutions and with expressions of respect and good feeling on the part of both.

The Trustees of Armour Institute of Technology will now endeavor to formulate final plans which in their judgment will best carry out the ideals of our Alma Mater and give the Middle West an engineering school second to none. It is believed that under a proper plan many large business and industrial concerns in Chicago and some of the wealthy and influential citizens of this city and state, appreciating the value to this community of a leading institution for engineering education, will solve the financial problem and perpetuate the ideals of the Institute.

In the working out of any program, the continued support of the Maintenance Fund for the next two years is very essential. As soon as constructive plans are formulated, you will be informed. Meanwhile, we look to the Alumni for a continuation of their loyal support and shall welcome any constructive ideas, suggestions and advice which they may wish to offer.

Among recent visits of the stork was one on April 4 to the home of Louis H. Pfohl, '24, a graduate of the civil engineering department. "Anna Mathias" is the name of the newcomer.

We have received word that Alan Tully, '28, c. e., has been spending several months in merrie England. Some fellows have all the luck.

Murray Lamm, '27, a graduate of the mechanical engineering department, died from strangulation on May 2nd. He was lying down and reading at his home at 4734 Ingleside Ave., when he was seized with a fit of coughing which proved fatal.

He was prominent in undergraduate circles, being editor-in-chief of the 1927 Cycle. He was a member of the Sphinx fraternity. He was employed by the Sefton Mfg. Co., on general engineering and production work.

Gordon S. Carr, familiarly known to many as "Doc" Carr, is now living in Warren, Ohio, where he is employed by the Packard Elec. Co., manufacturers of electric cables for automobiles.

Prof. H. R. Phalen, in whose classes many an alumnus learned of the mysteries of higher mathematics, writes to his old friends here from Saint Stephens College of Columbia University, where he is the head of the department of mathematics. He is also coach of the crack cross country team of that college, and the ice hockey team.

Walter J. Bentley, '20, assistant professor of chemical engineering, has recently been elected secretary of the Chicago Chemists' Club, on the board of trustees of which organization sits Prof. B. B. Freud.

B. F. McAuley, '09 m. e., who is in the engineering department of the Western Electric Co., recently was appointed chairman of employee athletic activities for the Hawthorne plant.

Alumni Golf Team Victorious

The alumni golf team, in its 24 point match with the varsity, defeated them 14½ to 9½. The alumni team was composed of Bates, '28; Miller and Lang, '27, and Dunlap, '25. The varsity team included Christiansen, Ong, Pfeifer and Weis.

LIFE AND DEATH

So he died for his faith. That is fine,
More than most of us do.
But, say, can you add to that line
That he lived for it too?
In his death he bore witness at last
As a martyr to the truth.
Did his life do the same in the past,
From the days of his youth?
It is easy to die. Men have died
For a wish or a whim—
From bravado or passion or pride,
Was it harder for him?
But to live—every day to live out
All the truth that he dreamt,
While his friends met his conduct with doubt
And the world with contempt.
Was it thus that he plodded ahead,
Never turning aside?
Then we'll talk of the life that he lived,
Never mind how he died.

—Ernest Crosby.

Fred Payne, '28, is now editor of the "Survey" of the Wisconsin Inspection Bureau. The Survey is a 25-page monthly paper.

A. G. Heino, '26, was a contestant in the preliminary competition for the Fellowship of the American Academy at Rome. The problem, which was completed in fourteen consecutive hours, consisted of the design and layout of nine city blocks of a specified civic project.

Announcement is made that Mr. Roy M. Henderson, '02, a trustee of the Institute, will head the newly formed United Engineers and Constructors, Ltd., of Canada, a subsidiary of the American company of the same name. Mr. Henderson has been vice president of Dwight P. Robinson Co. for several years. The new American firm was formed by a merger of the Robinson Co. with several other concerns.

The annual varsity-alumni baseball game was won this year by the varsity, 10-2. The game was played the Monday of Junior Week, May 13. After the game an alumni reunion and banquet was held by the Honor A Society, in the field house. John Schommer, '12, and Samuels, '24, occupied the mound for the alumni.

Annual Banquet May 28

The annual banquet of the Alumni Association is to be held Tuesday, May 28, at the Palmer House. Mr. Julian B. Arnold is to be the speaker.

News Celebrates First Birthday

Tuesday, April 9th, the *Armour Tech News* celebrated its first anniversary with its thirty-first issue under the editorship of John Hommes. The *News* had made its first appearance one year prior to that date in an attempt to prove that such a publication was practicable at Armour Institute.

Considerable opposition was first advanced against the founding of the paper, on the ground that it would be a financial failure and that the students already were too busy for such an undertaking. These objections were finally overcome and the *News* established, appearing five times before the end of the semester in spite of the gloomy future predicted for it.

Since its inception a year ago it has increased both in size and frequency of appearance, so that whereas it started as a five column sheet appearing every two weeks, it is now a six column paper appearing weekly. It has fully demonstrated its worth and is now a firmly established institution at Armour.

Jay E. Petersen, '26, instructor in Architectural Design, placed among the first four for the Final Competition for the Paris Prize. The Final Exercise will consist of the developing and rendering of a "Memorial to the Spirit of the West" consisting of a Monument, the court or courts of Fame, and an Open Air Theatre. The monument is to be primarily inspirational in value and through its beauty of form and charm of detail will memorialize the sacrifices of the past and become an inspiration for the future.

But soon a wonder came to light that showed the rogues they lied:
The man recovered of the bite, the dog it was that died.
—Oliver Goldsmith.

TRUE LOVE

The Girl: "Are your sure you love me?"
The Boy: "Do I! Why when we were saying good night the other morning, your dog bit a piece out of my ankle, and I didn't notice it until I changed my socks a week later."

Stanley says that the best example of rigid economy that he knows of is a dead Scotchman.

A good definition of influence is something that you think you have until you try to use it.

Caller: "And is this the new baby?"
Fond Papa Olson: "Isn't he splendid? And so bright—why see how intelligently he breathes."

PATHOS

The most touching scene arose when the doomed man, for his last wish, asked that the warden hold his hands when he was to be electrocuted.

A traveler who believed himself to be the sole survivor of a shipwreck on a cannibal isle hid for three days in terror of his life. Finally, driven out by hunger, he discovered a thin wisp of smoke rising from a point inland. Crawling there cautiously on his hands and knees, he arrived just in time to hear a raucous voice demand:

"Why the blinkety-blankey-blank did you play that blank-blanked card?"

"Praise the Lord!" gasped the survivor, kneeling devoutly. "They are Christian."

First Poet: "How like a flower she stands
With wind-tossed locks unfaded by the sun."
College Men: "Yes, and the last time she faded, she dyed."

"Excuse me, sir," suggested the taxi driver respectfully, "but your son always gives me twice as big a tip as this."

"Well, he can afford it," replied Mr. Spiegeldunk. "He's got a rich father."

IT PAID TO HESITATE

A man who conducted an unprofitable business took out a fire insurance policy. The same day a blaze broke out that completely destroyed the building and all the contents.

The insurance company fought desperately to find sufficient grounds to refuse payment of the policy, but in vain, and was obliged to content itself with the following letter appended to the check:

"Dear Sir—We note that your policy was issued at 10:00 o'clock Thursday morning and that the fire did not break out until 3:30. Will you kindly explain the delay?"

OVERTONES

I heard a bird at break of day
Sing from the autumn trees
A song so mystical and calm,
So full of certainties,
No man, I think, could listen long
Except upon his knees.
Yet this was but a simple bird,
Alone, among dead trees.
—William Alexander Percy.

Progress is that which a committee reports when it hasn't done anything.

An author is a most peculiar animal. His tale comes out of his head.

BITS OF WIT

If you live in a brick house, don't throw glasses.

Many an egg may be cooked long enough, but not soon enough.

A past may be black, a future uncertain, but a present is always acceptable.

When a girl looks her best, she is ready to do her worst.

Many a math quiz is just a guessing contest.

An ancient car chugged painfully up to the gate of the races. The gate-keeper, demanding the usual fee for automobiles, called:

"A dollar for the car."

The owner looked up with a pathetic smile of relief and said, "Sold."

IN GAY PAREE

First American: "Well, I didn't want any entree, so I ordered Roquefort."

Second American: "Why you fool, that ain't a meat, its a wine."

"Should a husband keep anything from his wife?"

"Enough for lunch and carfare."

GOOD FISHING

"I caught my husband flirting."

"Well, that's one way of getting one."

The modern girl is buying her dresses on the installment plan. It seems that they wear just one installment at a time.

STABLE MANNERS

Hoarse Voice: Kiss me.
Female Answer: Neigh.

You always lose your standing by lying.

SPORTSMANSHIP

When he asked her if she necked, she said, "You pet I do."

Mike was working in a shipyard. The first morning the foreman put in his hands a two-foot rule and told him to measure a large steel plate.

"Well, Mike," asked the foreman later, "what is the size of the plate?"

A satisfied grin spread over Mike's face. "It's just the length of this rule and two thumbs over, with this brick and the breadth of my hand, and my arm from here to here, bar the finger.

A young man from the Amazon
Put nighties of his gramazon;
The reason's that
He was too fat
To get his own pajamazon.
—College Life.

Sweet Female (listening to the orchestra): "What's that out of?"

Dumb Female: "Tune."

One way to trap a beaver

NOT everybody in the Hudson's Bay Company was a trapper, any more than everybody in the Bell System is a telephone engineer.

The Hudson's Bay people trapped a good many beavers in the company offices, where the skilful financing and careful business management served to back up the men actually on the front lines. Organized activity succeeded then just as it does today. The men who put up telephone lines can work the better because back of them are other men who painstakingly design and make their equipment, and still other men who correlate all these activities into a smoothly meshing plan.

—nor is every man at Western Electric an electrical engineer

THE vast manufacturing industry of the Western Electric Company —a business of well over 250 million dollars annually— embraces activities not only in electrical and mechanical engineering but also in many non-technical fields.

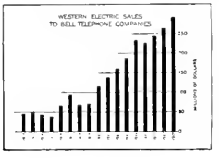
Buying everything from grass seed to telephone poles

For example, economics and business management play important parts in gearing the entire physical plant and production schedule to the country's future requirements for telephone service.

Moreover, Western Electric not only buys or makes everything the Bell System uses but delivers it where and when needed.

A nation-wide warehousing and distributing system has been developed that meets the highest standards of modern business practice.

Thus work in Western Electric appeals to men who later on may develop aptitudes for merchandising, statistical analysis and business administration.



An interesting work is the preparation of statistical studies of the Company's activities and the analysis of general business conditions in this country and abroad.

A nation-wide service of supply. At 32 important points Western Electric maintains stocks to be drawn upon as needed by the telephone companies.

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

FROM NEWS TO NEWSPAPER

(*Continued from page* 133)

trips through the different channels used to reach readers.

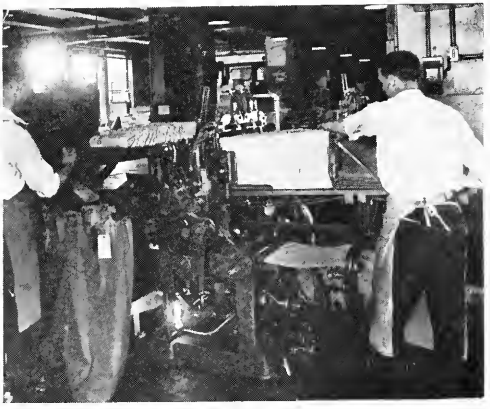
Here is where the "mechanical count" made by the presses comes into play. A special device in the conveyors "jogs" every fiftieth paper at an angle to the others. The men in the mailing room, by watching the "jogs" as the papers flow past on the conveyors, can take their papers in lots of fifties, without having to count them. Elimination of hand counting, which still is practised by many large newspapers, is a considerable factor in enabling the mailing room to discharge all its responsibilities on time.

The large bundles are those sent by mail, express, or baggage, to newsdealers in other cities. These shipments are made in bundles containing from 50 to 100 papers. The bundles are sometimes dropped from trains speeding at sixty or seventy miles an hour, and must, therefore, be wrapped securely enough to stand such handling without damage. The wrappers are addressed three hours ahead of press time, according to the orders on hand from the various newsdealers and newsstands, and are laid out, together with cords of the proper length, in readiness for the midnight rush. When wrapped and tied, the bundles are placed on belt conveyors which converge toward the southwest corner of the mailing room and deliver the bundles to the waiting trucks, properly tagged for their destinations.

The tags themselves are made to speed the process by means of their colors, one color being allotted to each railroad station in Chicago. This eliminates the necessity of reading the tags to learn where the bags are to go. Whenever the platform men see a red tag, they know the bundle is for a train leaving the La Salle street station, and throw it on a truck bound for that point. A white tag earmarks bundles destined for the Dearborn station, and so on, seven colors being used in all. Nearly a third of a million tags are used every year.

Loading of the trucks is controlled by two men. One, in charge on the platform, controls the movements of trucks to and from the loading points. The other man is in the dispatching tower, from which he can see both the platform and the inside of the mailing room. He sees to it that the bundles for different trains come to the platform in the proper order, calling for "New York Central," "Pere Marquette," and other classifications of bundles in the order they must be sent to catch the respective trains.

More intricate work is necessary when it comes to getting out the papers sent by mail to individual subscribers. These papers fall into two classes, known as "singles" and "clubs." Where there is only one subscriber in a town, the papers are sent through machines which fold, address, and drop them into mail bags—one bag for each route used. These are the "singles," and the papers used for this class of mailing must be specially printed, one of the two "ears" bearing the name of the edition being left off to provide space for the address.



The special machines which fold and address the papers and drop them into waiting mail sacks.

The same type of machine after being adjusted for the purpose, handles the papers going to towns where there is more than one mail subscriber. When adjusted for the work, this machine prints the names and addresses of subscribers at an average rate of 12,000 papers an hour. The stencils for each route are together and the last one for each town on the route makes a red mark on the Tribune in addition to the address. As the papers flow from the addressing machines, men seize those between red marks, roll them in wrappers, and drop them into a mail bag between them. The stencils have been all arranged so that all towns on a given railroad route are grouped together. At the end of each train separation, the bag containing mail for that route is closed and sent on its way to the train, and another takes its place. On these bundles, commonly known as "club packages," the address on the outside serves as postoffice address for the entire bundle.

Meanwhile, in all the hurly-burly, there is one exceedingly important matter which cannot be overlooked. The United States government expects payment, naturally, for all the matter sent by mail. But it would be impossible to scrutinize each bundle as it leaves to ascertain the postage, and still catch the trains. To solve this problem, the postoffice has a government scaler on hand. The scaler weighs each outgoing truckload, and gives the driver a slip stating the weight. This slip the driver gives to the transfer clerk at the station, and the slip is the clerk's authority for receiving the shipment. The slips are turned in to the Central Post Office, and next day a post office representative and a newspaper man figure out, from these slips, from the circulation orders of the previous evening, and other data, what postage the paper owes. The amount due is paid, and thus all interests involved are satisfied without occasioning any delay in handling the papers.

The Tribune employs approximately 200 full time men in the mailing room, together with seventy "extras" who work part time on the Sunday editions, and uses about 29,000 square feet of floor space to carry on these activities. A further insight into the tremendous scope of its activities comes from the fact that it uses nearly a third of a million pounds of rope in a year just to tie its bundles, and over a third of a million pounds of wrapping paper.

Space does not permit us to describe many of the other interesting activities entering into the manufacture of a daily newspaper. From what we have written we think a good idea of the extent of such a task can be obtained. Speed of production, combined, of course with accuracy and beauty of presentation, is the fundamental objective underlying all of the highly intricate mechanical operations entering into newspaper manufacturing. To be successful a great metropolitan newspaper must be on time. If it isn't, it slips and leaves the race to its more enterprising competitors. Many of the Tribune's time and labor saving methods and devices are of its own invention. A newspaper whose circulation grows by such gigantic leaps and bounds as does that of the Tribune cannot depend entirely on the accidental discoveries of mechanical genius. Its own plant is a splendid mechanical laboratory for

observation and experiment. Hardly a year goes by but some fruit of this experimentation and observation on the part of its own production department is born to give greater efficiency in the enormous task of turning out over six million newspapers every week.

DIESEL ENGINES

(*Continued from page* 135)

restricted opening. Here the injection pressure is moderate, as it is not depended on to completely atomize the fuel.

The other method may be called the high pressure injection system, for want of a better name. In this, the fuel is injected under a pressure which may be as high as six or eight thousand pounds per square inch. The combustion chamber and location of the nozzle and air inlet valve is so arranged as to give turbulence to the air. This, in connection with the high injection pressure assures good combustion, the pressure atomizing the fuel, and the turbulence providing good mixing.

As the injection nozzle is a very important part of the Diesel engine, it may be well to describe the two general types briefly. They are the "open" and the "closed" type.

The open type is very simple, being merely an orifice or number of orifices to spray the fuel into the cylinder. It contains no check valves or other moving parts.

The closed nozzle is more complicated. Fig. 2 gives a section view of an Acro Bosch nozzle for use on small high speed Diesels. The orifice is normally closed by the plunger which is held down by a spring, the pressure of which may be varied by the adjusting screw at the top. The fuel enters from the pump through the small inclined passage on the right. From here it goes to the annular space around the bottom of the plunger. When the pressure of the fuel builds up to a predetermined amount the plunger is automatically raised by the differential pressure on the conical surface near its lower extremity. When the required amount of fuel has been injected, the pressure in the line falls and the spring forces the plunger down against its seat. This gives a sharp cut off and prevents dripping of the nozzle, which is undesirable. The small knurled knob at the top is for the purpose of detecting a nozzle that is not operating. If the knob is depressed against the light coil spring holding it up, it will touch the top of the plunger so that the operation of the nozzle can be felt. This type of nozzle is generally used on antechamber type engines.

A diagram of a representative engine of the pressure injection type is shown in Fig. 3. It resembles more or less closely the conventional four cycle overhead valve gasoline engine. In place of a spark plug there is an injection nozzle on either side of the combustion chamber arranged so as to send fuel across the narrow space between the piston and cylinder head. The two nozzles are directed towards each other so that when the sprays meet, turbulence is produced.

This type of engine is made in sizes of from 40 to 100 h.p. and rotates at 1,000 r.p.m. It is but little larger and heavier than a gasoline engine of like capacity.

The injection system consists of a plunger type pump for each cylinder. There are numerous cams, rocking levers, and valves used, so that the device is rather complicated, but seems to operate quite satisfactorily nevertheless.

A type of antechamber design engine is shown in Fig. 4. Most of the clearance volume is in the chamber so that on the compression stroke air flows into it with violent turbulence through the restricted opening at the bottom. When the fuel is injected, the pressure rises rapidly in the chamber as combustion begins and

THE FURNACE BEHIND THE FACT

Back of the five remarkable qualities that give Reading Genuine *Puddled* Wrought Iron Pipe its long, long life stands the flame-filled puddling furnace—the time-tested method of making genuine puddled wrought iron.

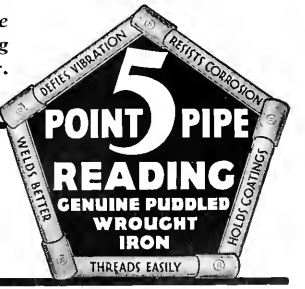
It is in the puddling furnace that the fiery, hot, pure iron and silicious slag are stirred and worked together until every inmost particle of the iron is coated with corrosion-defying slag. Out of the puddling furnace comes genuine *puddled* wrought iron—the same wrought iron that has been so famous for generations.

You can buy *proved* pipe dependability, freedom from frequent replacements and uninterrupted production by insisting on Reading Genuine Puddled Wrought Iron Pipe. Your protection from untried substitutes is the Reading name, date of manufacture and spiral knurl mark on every piece of Reading Pipe.

READING IRON COMPANY, Reading, Pennsylvania

Atlanta	Cincinnati	Pittsburgh	Fort Worth
Baltimore	Detroit	Cleveland	Seattle
Boston	Houston	St. Louis	Philadelphia
Buffalo	Los Angeles	Tulsa	New Orleans
Chicago	New York	San Francisco	

Reading tubular goods are furnished in sizes ranging from ⅛″ to 20″ in diameter.



READING PIPE
***GENUINE* PUDDLED WROUGHT IRON**

as a result the mixture of burned and unburned fuel is forced out with great velocity and combustion proceeds in the combustion chamber proper. This method generally gives good combustion since the gases are kept highly agitated, which insures thorough mixing of the fuel and air. This type of engine is especially popular in Europe. It has the advantage of not requiring excessive injection pressures, which simplifies somewhat the problem of fuel pump design. Often this type of engine is operated at lower compression pressures than the average Diesel, the antechamber walls being depended on to retain a certain amount of heat from one cycle to the next and so provide a sufficiently high temperature for ignition. In such engines some special form of ignitor or hot spot is needed for starting when the engine is cold, for the heat of compression alone is not sufficient to cause ignition of the fuel.

In the Acro Bosch system, the air inlet ports are equipped with small electric heating units, which are turned on for a short time previous to starting the cold engine. They raise the temperature of the incoming air and so make ignition more certain.

There is another and very different angle from which the problem of the light weight high speed Diesel has been approached. This is the compound engine, consisting of two high pressure cylinders operating on the four stroke cycle and one low pressure cylinder operating on the two stroke cycle, both high pressure cylinders discharging into it. The high pressure cylinders are highly supercharged, which increases the mean effective pressure, and enables a high power output to be obtained from a comparatively small engine. The reasons why it is advantageous to compound a gasoline engine are interesting. It will be remembered that one of the reasons given for the high specific weight of the Diesel was that it had to be constructed heavier and stronger because of the high pressure handled. A reference to the indicator card will show that these pressures only exist for a brief portion of the cycle, the pressures at other phases being quite moderate. In the compound, only the small high pressure cylinders need to be built heavy enough for the maximum pressure, the large low pressure cylinder being subjected to pressures much less than those ordinarily encountered in internal combustion engines. The result is that the engine may be made quite light.

It is reported that this engine operates on the constant volume cycle, which means that combustion is very rapid and so the engine can attain high speeds. Due to the number and arrangement of the cylinders the engine has a more uniform turning effort, there being two power impulses per revolution, one from a high pressure cylinder and one from the low. Very high economy is claimed for this engine, as the expansion ratio can be increased to values which would be impracticable in a simple engine.

In spite of its apparent advantages this engine has not been in wide use, only a few having been made.

A distinct step in advance was made recently when the Packard Motor Car Co. announced an aircraft Diesel engine weighing less than three pounds per horsepower. It has a fuel consumption of about .35 pounds per h.p. hour at about 1,600 r.p.m. This engine, which has actually been used in an airplane, is of the radial air cooled type. It is reported to operate very satisfactorily, and is perhaps the first Diesel to be actually used for airplane work.

In common with practically all of the other high speed Diesels, the Packard engine does not operate on the true constant pressure Diesel cycle, but operates on the mixed cycle, in which part of the fuel is burned at constant volume and the remainder at constant pressure. Very high maximum pressures are encountered, being of the order of 1,200 pounds per square inch, but it is claimed that a cylinder construction has been developed which handles this pressure without using excessive weight of metal. The mean effective pressure compares favorably with that of the gasoline engine. A theoretical indicator card for this engine is shown in Figure 1.

In conclusion it might be well to summarize the general methods by which the Diesel is made lighter and faster. The chief problem has been to control combustion, this having been accomplished by varying the degree of atomization and the time of injection in the pressure injection system, by the use of an antechamber in the system of that name, and by the use of turbulence in both systems.

The mean effective pressure depends largely on the nature of the combustion, so that by controlling the combustion the mean effective pressure can be controlled, assuming constant volumetric efficiency and air excess. For example in the Packard engine the fuel is injected as early as 50 degrees before dead center, giving a very high maximum pressure and also a high mean effective pressure. In general it is necessary to increase the maximum pressure in order to increase the mean effective pressure.

The problem of making a fuel pump capable of operating at high speeds under the difficult conditions enumerated above has been found to yield to careful and ingenious designing, but many of the pumps are quite complicated and are probably as yet the weakest link of the high speed Diesel.

However, much research and experimental work is being done at present in the United States, Germany, England and Canada to perfect the engine and in the near future we may expect to see the Diesel widely used for motor vehicle and aircraft work.

The author is indebted to Capt. L. M. Woolson of the Packard Motor Car Co., and to the Robert Bosch Magneto Co. for much of the information used in the preparation of this article.

US ENGINEERS

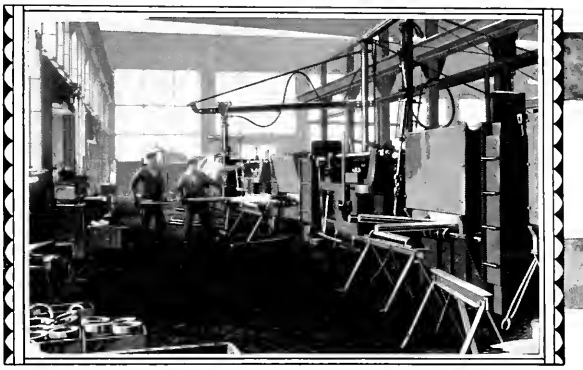
(*Continued from page* 129)

than in anger, he applies the blue pencil, thinking as he does so: "Such an eccentric never was on land or sea." Stripped of its poetic expression and reduced to the language of the engineer, the professor's comment simply means, of course, that such a device was never used in stationary or marine practice.

In addition to very meager information on his subject, this student lacks the mechanics of adequate expression, the words and phrases in which to clothe his ideas. An eccentric might have been called a device, a piece of mechanism, a part of a valve gear, but "thing" is not very expressive. He has not learned that a strip of metal in a slot is a key, and instead of bolt he means set-screw. His ideas as to how the eccentric slips are entirely chaotic and the whole dictionary would not help him here.

An inadequate equipment of words is a common, but not a serious, cause of poor speaking or writing. It is not serious because it can be overcome, and usually is, if one is observant in reading and in conversation. Seeing and hearing words used correctly can hardly fail to increase the vocabulary, except in the case of those hopelessly unobservant and lazy.

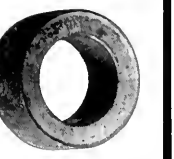
Several students are just about to leave Machinery Hall, their minds intent on lunch at the fraternity house. One of their number, however, declines to go with them, and turns toward the library. "No lunch for me today, fellows; I must finish these notes and get them in to the professor of cold storage by one o'clock, or I'll flunk the course." So he goes to



A corner of New Departure's mammoth Forge Plant — one of the largest in the world — where a unique upset forging process gives peculiar endurance to the finished ball bearing.

First form

Second form



Completed forging

Forging the Sinews of Endurance

UPSET forging plays an interesting and important part in making the New Departure Ball Bearing so enduring that it will outlive the machine in which it is installed—*and yet never wear within itself to the extent of requiring adjustment.*

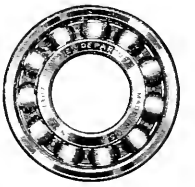
This method increases the density of the steel by compression and likewise controls the flow of the steel fibre—a feature with a direct bearing on endurance life, as will be explained.

The bar is first heated to an exact temperature checked constantly with optical pyrometers to obtain a non-oxidizing atmosphere for the prevention of scaling.

The first blow of the forming die in making the inner race ring produces the shape shown in the first form. This is immediately followed by the second operation, by which the ring is formed. The third or piercing operation cuts the ring from the bar.

Thus the fibre or grain of the steel flows into carefully predetermined channels, bringing it *parallel* to the surface at the points of greatest load in the finished and revolving bearing.

Normalizing and annealing operations which follow relieve all internal strains and greatly refine the grain size of the steel. The direction of the fibre for maximum endurance remains unchanged.



New Departure Ball Bearings

The New Departure Manufacturing Co.
Bristol, Connecticut
Chicago · Detroit · San Francisco

1106

the library and writes frantically during the noon hour.

When the professor reads these notes prepared by the lad with the high-speed pen, his eye falls on this sentence: "Cold storage has made it possible to freeze meat and is responsible for the high price of eggs."

In the course of his lectures the professor had stated that mechanical refrigeration and cold storage had made possible the frozen meat industry, as a result of which almost the entire world had become a possible market for fresh meats prepared in America. Later, in discussing some of the economic results of refrigeration and cold storage, he pointed out that it had greatly reduced the seasonal price fluctuations in many commodities, notably eggs, by providing a market in times of large production, and a source of supply when production is low. Out of these two unrelated observations of the lecturer the student had evolved one rather remarkable sentence.

This is another example of a writer with very little knowledge of his subject, but it also shows a complete lack of logical arrangement. Unrelated statements are tied together with a conjunction, but they served no useful purpose and the result is nothing but confusion. No capable engineer would start to build a bridge until it had been planned to the last detail. He will often, however, start to write some important document with no plan, no logical arrangement in mind. He may be a master of his subject, he may know and observe all the rules of grammatical construction the entire verbal resources of the language may be at his disposal, and yet the result is little better than a hodge-podge. Engineers sometimes wonder why they study logic but if it teaches them logical sequence in their spoken or written treatment of a subject, it comes close to being the most valuable subject in the entire curriculum.

The Alumni Executive Secretary, employment agent for the university, replaces the telephone receiver on the hook and turns again to his overloaded desk. "There's a good job for some young graduate; the particular course that he took doesn't matter much, and he need not have been an 'A' man, in his studies; but he must be able to write a good letter, he must know how to present a proposition, orally or in writing, in an attractive and convincing way. Where am I going to find such a young man?"

If students of engineering could only realize the vital importance to them of a command of good English, could understand what a large factor it is in nearly every substantial success, they would soon forget the foolish notion, expressed by many a rebellious student that "us engineers don't need no English."

WENR

(*Continued from page* 137)

ferred by an air core transformer to a transmission line which carries the radio-frequency energy to the tuning house, a small brick building located in the rear of the transmitter building. An electrostatic shield is used between the coils of this output transformer. The transmission line is connected in parallel with a condenser in the tuning house. One terminal of this condenser goes directly to the antenna. The other terminal is connected through an inductance to the ground system. At the present time about 49.5 kilowatts are being delivered to the antenna system.

(This station does not indulge in advertising or chain broadcasting.) It is a means of furthering the "good will" of its owners among its thousands of listeners. Possibly the policy of the station is best expressed in its familiar announcement, "WENR, The Voice of Service."

Although its capacity far exceeds that of any other Chicago station, there

seems to be no exceptional interference from it. This indicates that such super radio stations can be operated in radio congested centers without causing undue interference. There is something more to the successful operation of such a station than the value of its capacity in kilowatts. A great deal depends upon the engineering used in its construction and operation. Radio is still in its childhood but the place and importance of the engineer in radio broadcasting is well established. The day of the "hay wire" station is passed as far as broadcasting is concerned, and the men who design, build, and operate the present day stations are more and more being recruited from men who have had an engineering education.

Those who know nothing of radio will find much pleasure in a visit to this station. Its appearance both without and within is pleasing to the eye, and to one who never before viewed a row of bright and shining 20-kilowatt tubes, the thought might come that he was not in a radio station but in an exhibit of glassware. Everything is arranged so well and kept so orderly that the apparatus involved in the complexity of it all appreciates its pleasant housing and as a result creates the "music in the air" which is at one's beck and call practically at any time.

There being no definite income from such an investment the question naturally arises, "Does it pay?" or "Does it support itself?" Recently one of the oldest stations in Chicago managed to support itself for one month. This particular station has an average cost of thirty dollars a day for tubes alone. But still there are demands pouring into the radio commission for permission to operate such stations. Somehow, someway, they must pay for themselves. However, the listening public cannot help but appreciate such a station as this.

As this goes to press, announcement is made that the eight 20 kw. tubes used in the power amplifier bank are to be replaced by two 100kw. tubes, connected in push-pull. The new tubes will be somewhat of a novelty in this section of the country. They will be four and a half feet high, and will be equipped with an air-blast cooling system in addition to the water system—the air blast being directed upon the junction of the glass and the copper, which becomes the hottest spot in the tube.

Another announcement is to the effect that the rectifier bank is to be replaced by six of the new hot cathode mercury vapor rectifier tubes, whose rating is 20 amperes at 18,000 volts. The unique feature is that the drop through these tubes is only 14 volts, instead of the 1,000 or so volts drop in the old style tubes.

It is also planned to install a television transmitter and a rebroadcasting transmitter at the Downers Grove station. Both are to operate on short waves, the former having a power of 500 watts, which will be increased to 5 kw. later.

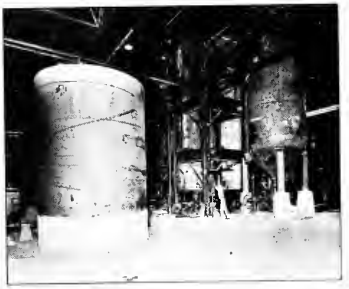
FUEL HAZARDS

(*Continued from page* 139)

they can be easily watched and tested for a rise in temperature, and if necessary the coal can be moved quickly.

The common methods of testing for the heating of a coal pile are:

1. By watching to detect evidences of steaming in the pile.



Part of the battery of digesters in the plant of the Cornstalk Products Company, Danville, Ill.

2. By noting the odor given off. The bituminous odor of burning coal or odor of burning sulphur are evidences of heating.

3. By inserting an iron rod into the pile and, when drawn out, noting its temperature by touching with the hand.

4. By noting places where snow on a pile has melted.

5. By means of maximum temperature thermometers inserted into pipes driven into the pile at intervals.

CORNSTALKS

(*Continued from page* 131)

before the chlorine or bleaching powder is added. After washing the bleached pulp, it is formed into sheets. These may be shredded or dried directly, and when baled are ready for shipment to the factories where the cellulose pulp is made into the necessities and luxuries of man.

The preparation of the cellulose pulp from the cornstalk is now complete, and the work of the plant at Danville ends here. The most important and valuable part of the work has been completed when the cornstalks have been gathered, shipped to the mill and converted into cellulose at a price below that of chemical wood pulps. From this point, numerous derivatives of cellulose have already been manufactured on commercial scale with great success; there seems to be no reason why the cornstalk cellulose should not replace all other forms of cellulose to an extent to make it the chief source of this human necessity.

When the work of the Danville plant is completed, there are many paths of distinct interest which complete the work and which place on the market the finished article. The foremost of these is the paper industry. The pulp obtained from the cornstalk has been found to be very satisfactory for the making of paper of all kinds. Recent tests made by the Technical Association of the Paper and Pulp Industry have shown the paper to be of excellent strength, although rather dirty and harsh, which make it objectionable for many purposes. The Bureau of Standards in its test on the paper making qualities of this pulp have found the same disadvantages, and they have recommended that a paper made of cornstalks with blended pulps may use this characteristic hardness to advantage in producing a paper with different and better qualities than any now on the market.

Research in this field has already accomplished many noteworthy results. Data obtained so far show that different parts of the stalk yield varying grades of paper: the fibrous outer shell used alone makes the strongest paper, the pith used alone gives a translucent, parchment-like paper, and paper consisting of mixtures of these two, as would be expected, has properties varying between these extremes. The husks and leaves produce the weakest paper. A blending of corn pulp with small or large percentages of sulphite pulp has been found to be perfectly practical and a high grade white paper has been made from a mixture of 10 per cent sulphite and 90 per cent corn and at a speed equal to the straight wood pulp sheets. It is possible to produce a corn news print equal in strength and appearance to the present wood news print by using a composition of 25 per cent cornstalks, 7 per cent sulphite, and 68 per cent ground wood. Already over 100 newspapers have become regular users of the corn pulp in their newspapers, and many paper mills have also become large users of corn pulp in their products. Various processes, known as the caustic soda, soda, Kraft, and halogen, make pulps suitable for magazines, books and writing paper. The lime-soda and sulphite processes give a

weaker paper, suitable for a toilet paper and similar grades, while the lime pulp seems suitable for box board and other articles, where an unbleached pulp can be used. Although the use of corn pulp in the paper making industries has made notable strides, it nevertheless has not entirely relieved the country of its anxiety in regard to its forest problem. The total output of our forests is so much greater than the present yield of the corn stalk paper that it will undoubtedly be some time before any definite notice of the place of corn pulp in the paper world will be recognized. The fact that good paper can be made from cornstalks at below present market prices has instilled the confidence that accompanies the knowledge that there is a source of supply for paper on which to fall back until further development will show the way to a greater and greater use in the paper industry.

Another promising field is the manufacture of cellulose for rayon, and the progress of the company's plant at Tilton, Illinois, is being watched with a great deal of interest in this connection. Still another field is the manufacture of nitrocellulose. It has been determined that both bleached and unbleached pulps nitrate readily and satisfactorily with a high degree of stability. At the present time the manufacture of wall board from stalks is the most promising proposition, and a factory for the manufacture of wall board will soon be started at Dubuque, Iowa. It is hoped that the commercial utilization of cornstalk cellulose will develop along each of two distinct lines. The first includes those applications which can utilize the entire stalk as crude fiber. Under this head would come wall board, cornstalk flour, and similar products. The other would use the finished cellulose in the manufacture of paper, rayon, nitrocellulose, cardboard, and similar products.

That the sponsors of the industry entered it with a clear foresight is evi-

IMPROVING BLASTING PRACTISE

ACCIDENTS are costly. Most of them are avoidable. They are usually the result of bad practises. To avoid them we must know the causes.

Records kept by the U. S. Bureau of Mines show that improper storage, handling, or use, are responsible for nearly all accidents with explosives.

Improper storage may involve damp or unventilated magazines, or simply the failure to enforce a system requiring that the oldest powder or detonators in the magazine shall be used before later shipments, to avoid unreasonably long storage of any explosive.

Improper handling and use include a greater number of unsafe or inefficient methods than can be enumerated in one advertisement. However the principal ones will be discussed in detail in a series of advertisements of which this is the first. We are publishing this series in the hope that it may help to improve methods of using explosives. We invite correspondence from those who wish further information on the subjects treated. Please address Hercules Powder Company, (Incorporated) Wilmington, Delaware.

COSTS CAN BE REDUCED BY BETTER STORING, HANDLING AND USE OF EXPLOSIVES

denced by an inspection of their research and development departments. At the beginning, the company gathered a competent research staff and built a well-equipped research laboratory at the Danville plant under the supervision of Dr. E. R. Darling. It was recognized from the start that a vast amount of systematic research would be required to study the process and treatments. At the present time the research work is being taken care of by three divisions. The purely scientific research work has its laboratory in New York City under Dr. J. E. Jackson; the plant control work also has its separate laboratory and organization; the third division is organized as a testing laboratory of chemical and mechanical processes.

Every possible phase of the work is being fundamentally carried out in the laboratory or in the field. Each step in the process is being studied, from the planting of the corn in the field to the most intricate reaction in the process. The investigations which the chemical staff have been making cover not only cornstalks but also the recovery of cellulose from the wastes, such as rice straws and hulls, oat hulls, cottonseed hull wastes from the cotton oil mills, and bagasse. These last two mentioned have particularly interested the company and separate test plants have been completed and operated for the recovery of cellulose with surprisingly satisfactory results. However, pure research is needed to develop more accurate and comprehensive knowledge of the characteristics and properties of the cellulose molecules. The man would need be foolish who would attempt to predict the additions to our wealth and comfort which may follow the utilization of our cellulose resources.

ENGINEERING NEWS

(*Continued from page* 141)

shaped magnet with laminated cores, large pole pieces, and two coils; and the track element called the "inductor," which is of similar design. The primary coil of the receiver is constantly energized from the turbo-generator of the locomotive, and the secondary is connected with the same circuit and also with a relay through which a small current flows normally. The inductors have a choke coil automatically controlled so that while the semaphore signal with which it is connected is at clear, the coil is closed on itself. If, however, the signal indicates caution or stop, a magnetic flux builds up in the secondary coil, producing current in the receiver as the receiver passes over the inductor. If the engineer fails to respond to the signal, this current causes the relay to open and apply the brakes through an electro-pneumatic device attached to the brake valve. Once the relay opens, the engineer cannot prevent his train from stopping and cannot reset the device until he can reach the reset button on the rear of the tender.

This rolling signal system is now in use on the main line of the New York Central between Croton-on-Hudson, New York and Englewood, a suburb of Chicago, the longest stretch of main line so protected in the U. S. Large stretches on other New York Central lines are similarly protected by train control.

Scientific Examination of Pictures

Within the last twenty-five years, the values of paintings by the old masters have become so greatly enhanced and the paintings are so constantly changing hands, that the question of authenticity has become one of great importance to the prospective buyer. The time when the expert examined the pictures with his unaided eye has passed; today the picture is put through a rigorous scientific examination which leaves very little doubt concerning its authenticity.